# WSDOT MITIGATION SITES
## OLYMPIC REGION

## 2002 MONITORING REPORT


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# Olympic Region Annual Monitoring Report

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# Executive Summary

The following tables summarize performance criteria and monitoring results that pertain to 2002.

| Site Name | Performance Criteria | 2002 Results |
|---|---|---|
| **SR 12 Black River** | <20% cover by invasive species each year through 2003 | 5% (CI $_{80\%}$ = 3-7% cover) |
| | At least 80% survival of woody species by 2002 | 93% (CI $_{95\%}$ = 88-100% cover) |
| | Wetland hydrology at least 12.5% of the growing season | Present |

| | | |
|---|---|---|
| **SR 7 Nisqually Slough** | 100% survival in the wetland | 97% (total count) |
| | Wetland hydrology | Present |
| | ≤ 20% cover by invasives | Wetland: 0.8% (CI $_{80\%}$ = 0-2% cover)<br>Upland: 12% (CI $_{90\%}$ = 9-14% cover) |
| | 100% survival in the upland buffer | 94% (total count) |
| | 20% cover by trees and 30% cover by shrubs in all areas | <5% (qualitative) |

| | | |
|---|---|---|
| **SR 161 Kapowsin** | 100% survival (or replacement of trees shrubs and herbaceous plants after one year) | 95% (total count) |
| | ≥ 30% FAC and wetter aerial cover on site | 94% (CI$_{95\%}$ = 91-97% cover) |
| | ≤ 20% aerial cover of invasive species in the wetland area | 14% (CI$_{80\%}$ = 11-17% cover) |
| | Hydrology within the wetland creation area present for 12.5% of the growing season | Yes |

| | | |
|---|---|---|
| **SR 509 Hylebos** | ≥ 80% aerial cover of planted woody vegetation in woody planted areas | 57% (CI$_{90\%}$ = 52-63% cover) |
| | ≥ 50% aerial cover of native FAC and wetter species in the emergent wetland | 34% (CI$_{90\%}$ = 28-40% cover) |
| | Presence of wetland-associated or -dependent species | Yes |
| | ≤ 10% aerial cover of non-native invasive species in the wetland | 16% (CI$_{80\%}$ = 12-20% cover) |

| | | |
|---|---|---|
| **SR 509 Erdahl Ditch** | ≥ 90% aerial cover of FAC+ or wetter species in the wetland | 95% (CI$_{80\%}$ = 56-100% cover) |
| | ≥ 90% aerial cover of vegetation in the wetland | 97% (CI$_{80\%}$ = 68-100% cover) |
| | ≥ 80% aerial cover of woody species in the buffer | 91% (CI$_{90\%}$ = 89-93% cover) |
| | Presence of wetland dependent species | Yes |
| | ≤ 10% aerial cover of non-native invasive species | 20% (CI$_{80\%}$ = 16-24% cover) |

# List of Acronyms

| Acronym | Meaning |
|---|---|
| CI | Confidence Interval (see Methods and Glossary) |
| ECY | Washington State Dept. of Ecology |
| FAC | Facultative Indicator Status (Reed 1988) |
| FACW | Facultative Wetland Indicator Status (Reed 1988) |
| MP | Mile Post |
| OBL | Obligate Wetland Indicator Status (Reed 1988) |
| SR | State Route |
| USACE | U.S. Army Corps of Engineers |
| WDFW | Washington Department of Fish and Wildlife |
| WSDOF | Washington State Department of Fisheries |
| WSDOT | Washington State Department of Transportation |

# Introduction

**History**
Infrastructure improvements including highway construction projects, highway interchanges, and bridges have accompanied economic and population growth in the state of Washington. The Washington State Department of Transportation (WSDOT) routinely evaluates the potential for degradation of critical areas that result from these infrastructure improvements. WSDOT strictly complies with applicable federal, state, and local environmental regulations, including the Clean Water Act and the state "no net loss" policy for wetlands (Executive Order 89-10). Generally, mitigation sites are planned when transportation improvement projects adversely affect critical areas. The WSDOT Wetland Monitoring Program monitors these mitigation sites as a means of evaluating compliance with permit conditions and tracking overall development. Forty-two sites state-wide were monitored in 2002 (Map 1).

**Purpose**
The purpose of this document is to report the status of Olympic Region WSDOT mitigation sites with respect to permit compliance and success standards for 2002 (Map 2).[1] We rely on feedback from the users of this report to ensure its contents are clear, concise, and meaningful.

**Process**
Monitoring typically begins the first spring after a site is planted and continues for the time period designated by the permit or mitigation plan. The monitoring period generally ranges from three to ten years. In special cases sites may be monitored beyond the designated monitoring period.

Monitoring activities are driven by site-specific success standards detailed in the mitigation plan or permits. Data are collected on a variety of environmental parameters including vegetation, hydrology, and wildlife. When data analysis is complete, information on site development is communicated to region staff to facilitate management activities as part of an adaptive management process. Monitoring reports are issued to regulatory agencies and published on the web at:

www.wsdot.wa.gov/environment/eao/wetmon/default.htm

[1] This map shows sites not included in this report. The excluded sites were evaluated for internal feedback only. A report is issued only for sites with success standards that apply to the current year.

# Methods

Methods used for monitoring mitigation sites change as site requirements and customer needs evolve. Quantitative data collection techniques presently in use are based on standard ecological and biostatistical methods.[2] The Monitoring Program's current methods include the following key elements:

Objective-based Monitoring

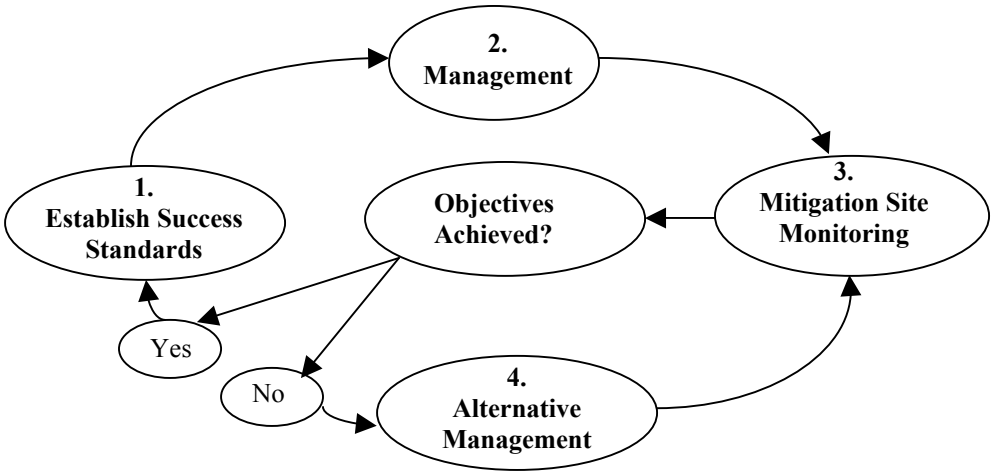
We collect data using a monitoring plan and sampling design developed specifically for each site. The monitoring plan and sampling design address success standards, permit requirements, contingencies, and other considerations as appropriate.

Adaptive Management

The adaptive management process includes four iterative steps:

1. success standards are developed to describe the desired condition,
2. management action is carried out to meet the success standard,
3. the response of the resource is monitored to determine if the success standard has been met, and
4. management is adapted if the standards are not achieved.

Monitoring is integral to the success of an effective adaptive management strategy. Without valid monitoring data, management actions may or may not result in improved conditions or compliance with regulatory permits. Timely decisions, based on valid monitoring data, result in increased efficiency and higher probabilities of success (Shabman 1995; Thom and Wellman 1996). The adaptive management process is illustrated in Figure 1.1.




(Redrawn from Elzinga et al. 1998).

**Figure 1.1 The Adaptive Management Process**

[2] These methods are based on techniques described in Bonham (1989), Elzinga (1998), Krebs (1999), Zar (1999), and other sources.

Statistical Rigor

The monitoring program strives to minimize subjectivity in data collection and increase the reliability of data collection and analysis. Important considerations include appropriate sampling design, sampling resolution, random sampling procedures, and sample size analysis. Our goal is to provide customers with an objective evaluation of site conditions based on valid and reliable monitoring data.

Success Standards and Sampling Objectives

Site objectives and success standards are important elements of a mitigation plan. They indicate the desired state or condition of the mitigation site at a given point in time. Conditional permit requirements, if different from success standards in the mitigation plan, are also evaluated during monitoring activities. Some mitigation plans also provide contingencies if a specific undesirable condition occurs. Contingencies typically initiate a management response at the onset of a particular condition, for example, excessive cover by invasive species or insufficient cover by trees and shrubs.

Monitoring program staff thoroughly examine goals, objectives, success standards, and site permits to understand the desired site condition or characteristics to be measured. Six elements are sought in relation to each success standard to ensure measurability of the desired condition: species indicator, location, attribute, action, quantity/status, and time frame. Where one or more of the six elements is undocumented or unclear in the mitigation plan or permit, clarification is sought from region staff.

Success standards are copied verbatim from the mitigation plan in the Success Standards and Sampling Objectives section of each site report. Several authors use the term "areal" differently than it has been used in many older mitigation plans.[3] We feel that the term "aerial" better describes the intent of the mitigation plans.[4] When "areal" is part of a success standard, we follow it with a (*sic*) notation. The glossary defines the meaning of these words as used in this document.

Information presented in the first table of each site report is obtained directly from the mitigation plan and permits, as appropriate.

Sampling may be required to address success standards unless an efficient and reliable total accounting of the target attribute can be conducted. Sampling objectives are developed to guide the data collection process. Sampling objectives typically include a confidence level and confidence interval half width.

The results of sampling are included in the individual site reports with the confidence level and confidence interval noted as ($CI_X = Y_1$-$Y_2$), where CI = confidence interval, X = confidence level, and confidence interval width is expressed as $Y_1$ low estimate to $Y_2$ high estimate. For example, an estimated aerial cover provided by woody species

[3] This distinction is based on definitions and usage in Bonham (1989), Hruby et al. (1999), and Williams (2001).

[4] Elzinga et al. (1998), Brower (1998), and Kent and Coker (1995).

reported as 65% ($CI_{80\%}$ = 52-78% aerial cover) means that we are 80% confident that the true aerial cover value is between 52% and 78% (Figure 1.2).

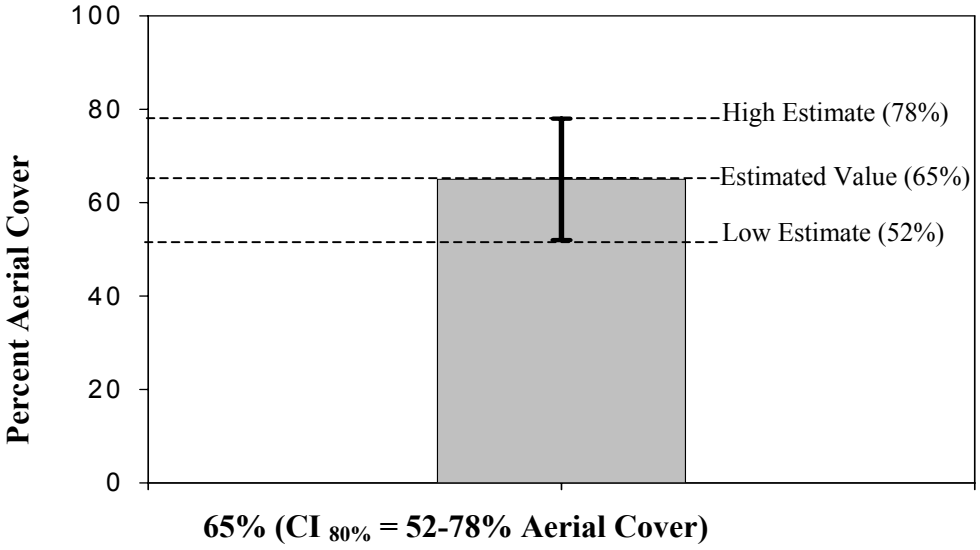



**Figure 1.2 Estimated Cover Value Expressed with Confidence Interval Range**

For compliance purposes, aerial cover calculations include only areas covered by rooted vascular plants (including floating-leaved species). Areas covered by thallophytes (algae, fungi, bacteria), bryophytes (mosses and liverworts), structures, or aquatic vegetation are not included in aerial cover calculations. Scientific names, most common names, and nativity used in this report were obtained from the *PLANTS Database* (USDA 2002). Hydrophytic plant indicator status was obtained from the *National List of Plant Species that Occur in Wetlands: Northwest* (Reed 1988 and 1993). Where invasive or noxious weeds are addressed, county specific listings in the *State Noxious Weed List* are referenced (Washington State Noxious Weed Control Board 2002).[5]

Sampling Design

When sampling is required, a sampling design is developed for the site or zone of interest. Sampling designs can vary from simple to complex depending on the number and type of attributes to be measured. Specific elements such as the size and shape of the site, the presence of environmental gradients, plant distribution patterns, and the amount of time and resources available for monitoring are factors that influence the sampling design. Elements of the sampling design may include the location of the baseline, orientation of transects (Figure 1.3), the method of data collection, and the number and type of sample units to be used. Depending on the sampling objective and site characteristics, transects may vary in number, length, and separation distance. Sampling transect locations are determined by using either a simple, systematic, stratified, or restricted random sampling method.

[5] In some cases, other nuisance species may be included in invasive cover estimates.

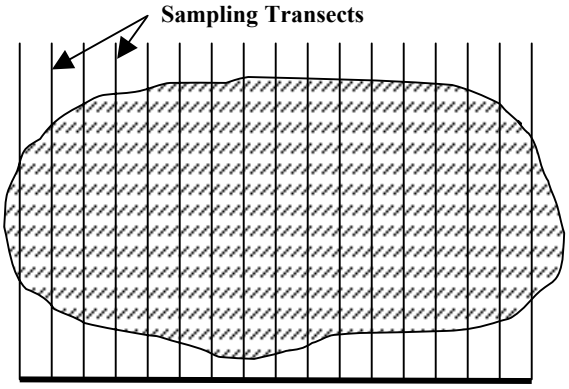



**Figure 1.3 Baseline and Sampling Transects**

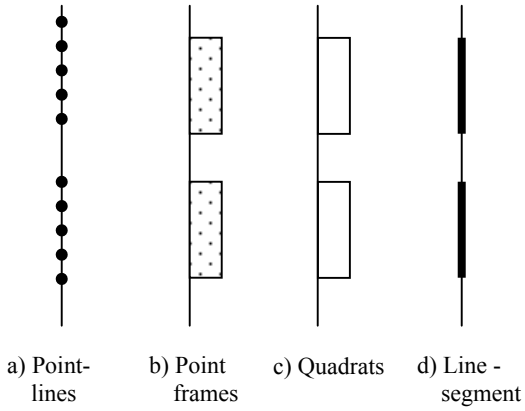



**Figure 1.4 (a-d) Sampling Transects and Sample Units**

A diagram showing the sampling design is typically included in mitigation site reports. Sample units appropriate to one or more of the methods described below are randomly located on or adjacent to the sampling transects (Figure 1.4 a-d). These drawings are general representations of the actual sampling designs and do not include specific details.

The Point-Line Method

The point-line technique (Bonham 1989; Elzinga et al. 1998) can be used where vegetative cover is an attribute of interest. This method involves randomly locating sample units consisting of fixed sets of points along sampling transects (Figure 1.4a). Tools used to collect point-line data include point-intercept devices, pin flags, or densitometers. These tools are used to identify point locations. Target vegetation intercepted by the point locator is recorded. If target species are not encountered on the point; bare soil, non-vascular plant, or habitat structure is recorded as appropriate. For each sample unit, cover is determined based on the number of times target vegetation is encountered divided by the total number of points. For example, if invasive species were encountered on 20 points from a sample unit composed of 100 points, the aerial cover of invasive species for that sample unit is 20%.

The Point-Frame Method

Point-frames are another tool that may be used to measure vegetative cover (Bonham 1989; Elzinga et al. 1998). A point frame is a rectangular frame that encloses a set of points collectively serving as a sample unit (Figure 1.4b).[6] The sample unit is lowered over herbaceous vegetation and data is recorded where target vegetation intercepts point locations. As with the point-line method, a cover value for each sample unit is determined. For example, if FACW and OBL species were encountered on 20 points in a point-frame composed of 40 points, the aerial cover of FACW and OBL species for that point-frame sample unit is 50%.

[6] The WSDOT Monitoring Program typically uses a frame formed with polyvinyl chloride (PVC). Strings span the frame lengthwise and points are marked on the strings using a standard randomization method.

Quadrat Method

To measure survival or density of planted trees and shrubs in an area, quadrat sample units are randomly located along sampling transects (Bonham 1989; Elzinga et al. 1998). Quadrat width and length are based on characteristics of the vegetative community and patterns of plant distribution. Quadrats are typically located lengthwise along sampling transects (Figure 1.4c). Plants within a quadrat are recorded as alive, stressed or dead. The success standard or contingency threshold can be addressed with a mean percent survival estimate of plantings, or a density per square meter of living plantings as appropriate. For example, if 8 planted woody species were recorded as alive and 2 were recorded as dead in a sample unit measuring 1 x 20 m, the survival of planted woody species for that sample unit would be 80%, and the density would be 0.4 live plants per square meter.

Line-Intercept Method

Cover data for the woody species community is collected using the line-intercept method (Bonham 1989; Elzinga et al.1998).[7] Line-segments, serving as sample units, are randomly located along sampling transects (Figure 1.4d). All woody vegetation intercepting the length of each sample unit is identified and the length of each canopy intercept recorded. For each sample unit, the sum of the canopy intercept lengths is divided by the total length to calculate an aerial cover value. For example, if woody vegetation was encountered on 80 meters from a 100 meter sample unit, the aerial cover for that sample unit is 80%.

Sample Size Analysis

With each of the above methods, sample size analysis is performed in the field to ensure that an adequate number of sample units are obtained to report the data at the specified confidence level and interval. The mean percent aerial cover value and standard deviation are calculated from the data, and sample size analysis is conducted. For data reported in this document, the following sample size equation for estimating a single population mean or a population total within a specified level of precision was used to perform this analysis (Elzinga et al. 1998).

$$n = \frac{(z)^2 (s)^2}{(B)^2}$$

$z$ = standard normal deviate
$s$ = sample standard deviation
$B$ = precision level[8]
$n$ = unadjusted sample size

A sample size correction to $n$ is necessary for adjusting "point-in-time" parameter estimates.[9] It is the adjusted $n$ value that reveals the number of sample units required to report the estimated mean value at a specified level of confidence.

[7] Depending on site conditions and other considerations, woody cover data may be collected using the point-line method and a densitometer.

[8] In this equation, the precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

[9] Adjusted $n$ values found in this report were obtained using the algorithm for a one-sample tolerance probability of 0.90 (Kupper and Hafner 1989; Elzinga et al 1998).

**Wildlife Monitoring**

Many mitigation plans include goals and objectives that address wildlife. For these sites, wildlife monitoring is conducted to provide information to support the results of the vegetation monitoring. An example of an objective that triggers such wildlife monitoring is presented below:

> Objective - Wildlife
> Wildlife cover and forage availability for birds and small mammals should increase substantially. The addition of fruit bearing shrubs and stumps, logs, and brush piles will increase habitat diversity and structure in the newly vegetated areas. Overall, creating an emergent and scrub-shrub wetland is intended to provide feeding, breeding, and resting habitat for birds, small mammals, and amphibians.

Some success standards contain more specific reference to monitoring wildlife. In these cases, a variety of wildlife monitoring techniques (see sections below) are used to evaluate success. An example of such a success standard follows:

> Success Standard:
> Development of habitat diversity and structure will be determined by the diversity and numbers of wetland dependent species identified during the monitoring period. The sites will meet this objective if wildlife species that utilize wetlands for some or all of their habitat requirements are located.

Incidental wildlife observations are recorded during all site visits.

Bird Monitoring

Sites with goals, objectives or success standards addressing the avian community receive three to four bird surveys conducted during the breeding season (April through mid-July). The point count method (Ralph et al. 1993) is used to document species richness and relative abundance.

Species diversity indices (H) may be calculated from bird survey data using the Shannon-Wiener function (Krebs 1999). Results are expressed as a mean annual species diversity index.

$$H' = -\sum_{i=1}^{s} (p_i)(\log p_i)$$

$H'$ = index of species diversity
$s$ = number of species
$p_i$ = proportion of sample belonging to $i$th species

The following *t* test is used to test the null hypothesis that diversity indices from different years are equal (Zar 1999).

$$t = \frac{H'_1 - H'_2}{S_{H'_1 - H'_2}}$$

$H'$ = index of species diversity
$S_{H'_1 - H'_2}$ = standard error of the difference between species diversity indices $H'_1$ and $H'_2$

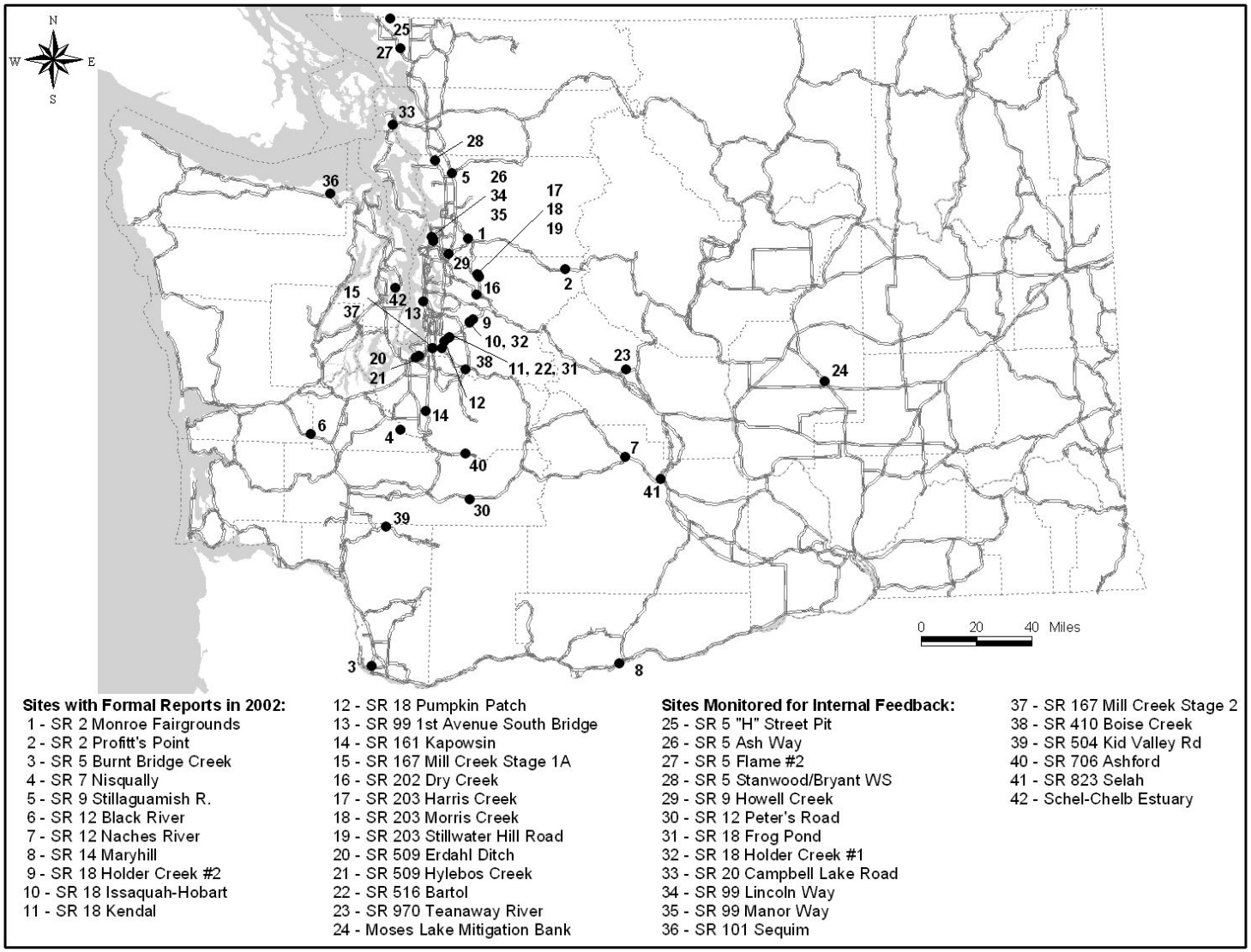
Amphibian Monitoring

Sites with goals, objectives, or standards referencing amphibians may be monitored using methods adapted from Olson et al. (1997). Methods may include funnel trapping on sites with a water depth of 1 dm or greater. Call surveys and area searches may be used to assess terrestrial components of sites without standing water. Incidental amphibian observations are recorded during other monitoring activities. Potential for amphibian habitat may be qualitatively assessed.

**Hydrology Monitoring**

Field indicators of wetland hydrology (Washington State Department of Ecology 1997) are recorded to address hydrology standards and to aid in future delineation efforts. Wetland mitigation sites are delineated after the last year of vegetation monitoring so that actual acreages can be compared to the planned wetland area.

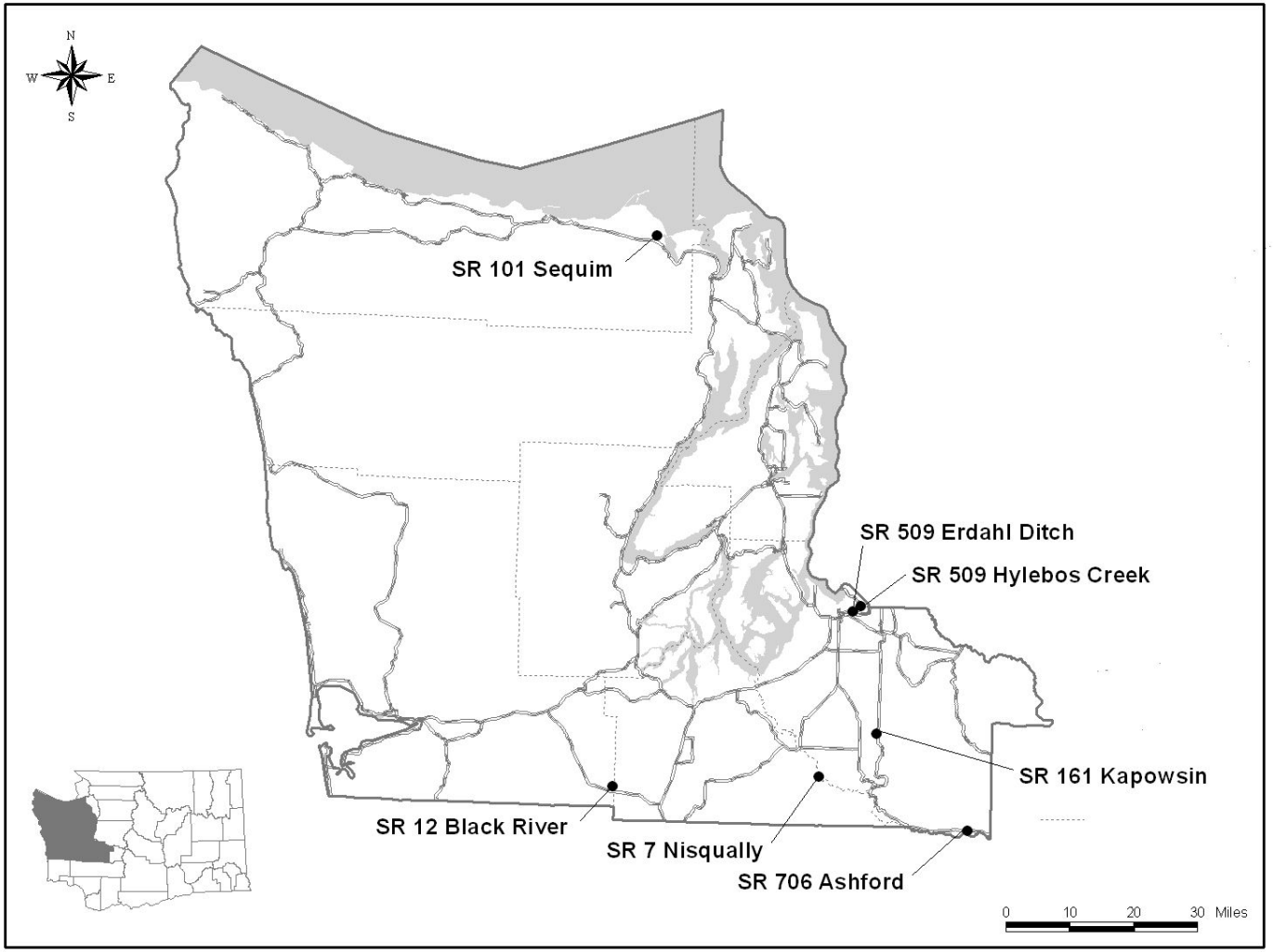
## Map 1: WSDOT Mitigation Sites Monitored in 2002




**Sites with Formal Reports in 2002:**
1 - SR 2 Monroe Fairgrounds
2 - SR 2 Profitt's Point
3 - SR 5 Burnt Bridge Creek
4 - SR 7 Nisqually
5 - SR 9 Stillaguamish R.
6 - SR 12 Black River
7 - SR 12 Naches River
8 - SR 14 Maryhill
9 - SR 18 Holder Creek #2
10 - SR 18 Issaquah-Hobart
11 - SR 18 Kendal
12 - SR 18 Pumpkin Patch
13 - SR 99 1st Avenue South Bridge
14 - SR 161 Kapowsin
15 - SR 167 Mill Creek Stage 1A
16 - SR 202 Dry Creek
17 - SR 203 Harris Creek
18 - SR 203 Morris Creek
19 - SR 203 Stillwater Hill Road
20 - SR 509 Erdahl Ditch
21 - SR 509 Hylebos Creek
22 - SR 516 Bartol
23 - SR 970 Teanaway River
24 - Moses Lake Mitigation Bank

**Sites Monitored for Internal Feedback:**
25 - SR 5 "H" Street Pit
26 - SR 5 Ash Way
27 - SR 5 Flame #2
28 - SR 5 Stanwood/Bryant WS
29 - SR 9 Howell Creek
30 - SR 12 Peter's Road
31 - SR 18 Frog Pond
32 - SR 18 Holder Creek #1
33 - SR 20 Campbell Lake Road
34 - SR 99 Lincoln Way
35 - SR 99 Manor Way
36 - SR 101 Sequim
37 - SR 167 Mill Creek Stage 2
38 - SR 410 Boise Creek
39 - SR 504 Kid Valley Rd
40 - SR 706 Ashford
41 - SR 823 Selah
42 - Schel-Chelb Estuary

## Map 2: Olympic Region Sites Monitored in 2002



# Grays Harbor County Sites

## SR 12 Black River, Grays Harbor County

The following report summarizes project activities completed by the Washington State Department of Transportation Wetland Monitoring Program at the SR 12 Black River mitigation site in July 2002. Monitoring activities include vegetation surveys and a qualitative assessment of the site with respect to third year success standards. Table 2.1 provides general site information and Table 2.2 shows this year's monitoring results.

**Table 2.1 General Site Information for the SR 12 Black River Mitigation Site**

| | |
|---|---|
| **Site Name** | SR 12 Vicinity Black River Br. & SR 12 Vicinity Moon Rd |
| **Permit Number** | SSDP-98-0882 |
| **Permitting Agency** | Thurston County SEPA/Shoreline Section |
| **Location** | North of SR 12 on Anderson Road, north of I/C with 175th Ave SW |
| **Township/Range/Section** | T.16 N/R.4 W/SE/4 S.27 |
| **Monitoring Period** | 2000 to 2004 |
| **Year of Monitoring** | 3 of 5 |
| **Area of Project Impact** | 0.77 ha (1.92 ac) |
| **Type of Mitigation** | Creation/Enhancement/Preservation/Total |
| **Area of Mitigation** | 1.17 ha (2.90 ac)/0.04 ha (0.11 ac)/1.82 ha (4.50 ac)/3.04 ha (7.51 ac) |

**Table 2.2 Monitoring and Management Summary from the SR 12 Black River Mitigation Site**

| Success Standard | 2002 Results[10] | Management Activities |
|---|---|---|
| 1. <20% cover by invasive species each year through 2003 | 5% ($CI_{80\%}$ = 3-7% cover) | Weed control |
| 2. At least 80% survival of woody species by 2002 | 93% ($CI_{95\%}$ = 88-100% cover) | Watering as needed, evaluating re-planting |
| 3. Wetland hydrology at least 12.5% of the growing season | Present | |

### Success Standards and Sampling Objectives

Success standards were developed from the *SR 12 Vicinity Black River Bridge & SR 12 Vicinity Moon Road Combined Conceptual Wetland Mitigation Plan* (Russell 1998). Companion sampling objectives follow where appropriate. Appendix A presents the text of the success standards developed for this site.

[10] Estimated values are presented with their corresponding statistical confidence interval. For example, 5% ($CI_{80\%}$ = 3-7% cover) means we are 80% confident that the true aerial cover value is between 3% and 7%.

Success Standard 1
Cover of reed canarygrass, or other invasive species may not exceed 20% of the total wetland area at the SR 12 Black River mitigation site at any time during years one through five (2000-2004).

Sampling Objective 1
To be 80% confident the actual cover of invasive species is within 20% of the estimated value (2002).

Success Standard 2
Vegetative success at the SR 12 Black River mitigation site must equal or exceed 80% survival of planted trees and shrubs by the end of year three, or additional planting (and monitoring) to achieve such (2002).

Sampling Objective 2
To be 80% confident the actual survival of planted woody species is within 20% of the estimated value (2002).

Success Standard 3
Hydrology (within 12 inches of the soil surface) within the wetland creation area must be present for at least 12.5% of the growing season (2002).

## Methods

To evaluate the vegetative community, 46 temporary sampling transects were established using a systematic random sampling method. Transects were extended east to west from baselines located on the west side of the site (Figure 2.1).

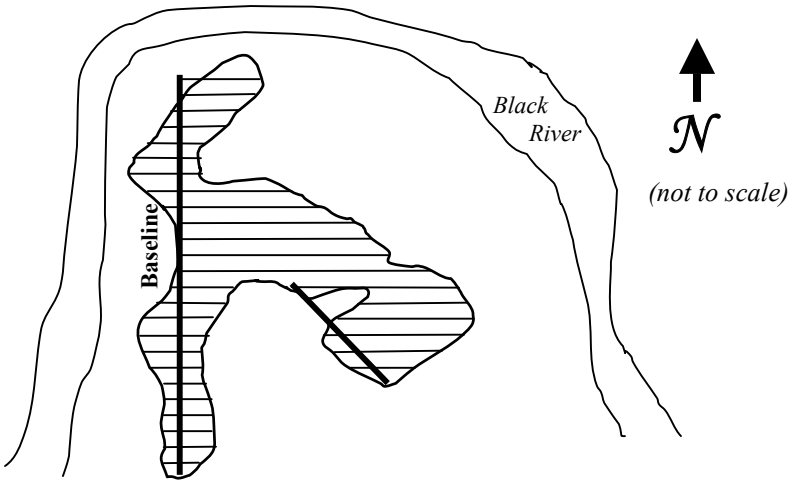



**Figure 2.1 SR 12 Black River Mitigation 2002 Site Sampling Design**

The point-line method was used to evaluate cover by invasive species (Success Standard 1) against the threshold limit of 20%. One hundred and nine 15-m sample units were randomly located along the sampling transects. Data were obtained at 60 point locations on each sample unit.

To evaluate woody species survival (Success Standard 2), data were collected from 53 quadrats (1×15 m) randomly positioned along sampling transects across the site. Planted trees and shrubs observed within the sample units were identified to species and recorded as alive or dead.

Sample size analysis was conducted using the following equation (Elzinga et al. 1998).

$$n = \frac{(z)^2 (s)^2}{(B)^2}$$

$z$ = standard normal deviate
$s$ = sample standard deviation
$B$ = precision level[11]
$n$ = unadjusted sample size

To evaluate wetland hydrology for Success Standard 3, hydrological field indicators were recorded during site visits in March, April and July 2002.

**Results and Discussion**

Success Standard 1 - Less than 20% Cover by Invasive Species

The estimated aerial cover provided by invasive species was 5% (CI $_{80\%}$ = 3-7% aerial cover), well below the threshold. Invasive species recorded on site include *Phalaris arundinacea* (reed canarygrass), *Cirsium arvense* (Canadian thistle) and *Rubus armeniacus* (Himalayan blackberry).

**Figure 2.2 SR 12 Black River (September 2001)**

[11] In this equation, the precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

Success Standard 2 - At least 80% Survival

Survival of planted woody species (including volunteer *Alnus rubra)* was estimated to be 93% (CI $_{95\%}$ = 88-100% survival) (Figure 2.2). *A. rubra* saplings have colonized large areas of the mitigation site contributing to the developing tree and shrub community.

Success Standard 3 – Wetland Hydrology

Most of the site was saturated to the surface this spring. Depressed areas were inundated to a depth of 1 decimeter (dm) in March and to 3 dm in April. The low elevation of the site and proximity to the Black River, suggests that the intended wetland hydrology is present in most years.

## Management Activities

Table 2.3 summarizes past and planned management activities at the SR 12 Black River mitigation site.

**Table 2.3 Summary of SR 12 Black River Management Activities**

| Date | Description of Management Activity |
|---|---|
| Fall/Winter 2002/2003 | Planning for additional re-vegetation and aquatic herbicide application. |
| Summer 2002 | *P. arundinacea* and *Rubus* species were removed by mechanical methods and spot spraying of herbicides. Watered plants as needed. |
| Summer 2001 | *P. arundinacea, Senecio jacobaea*, and *Rubus* species were removed by mechanical methods and spot spraying of herbicides. Watered plants as needed. |

# Pierce County Sites

## SR 7 Nisqually Slough, Pierce County

The following report summarizes monitoring activities completed by the Washington State Department of Transportation Wetland Monitoring Program at the SR 7 Nisqually Slough mitigation site in July 2002. Monitoring data were obtained to compare to first year success standards. Activities include vegetation surveys of the woody and herbaceous plant communities. Table 3.1 provides general site information and Table 3.2 summarizes this year's monitoring results.

**Table 3.1 General Site Information for the SR 7 Nisqually Slough Mitigation Site**

| | |
|---|---|
| **Project Name** | SR 7 MP 40 to MP 42.5 |
| **USACE Permit Number** | NWP 23: 2000-4-00954 |
| **WDFW HPA Permit Number** | 00-E4638-01 |
| **Mitigation Location** | South of Wilcox Farms near the Nisqually River, Pierce Co. |
| **Township/Range/Section (impact)** | T.18N/R.3E/S.24, 25, 36 |
| **Monitoring Period** | 2002 to 2006 |
| **Year of Monitoring** | 1 of 5 |
| **Area of Project Impact** | 0.30 ha (0.75 ac) |
| **Type of Mitigation** | Wetland Creation |
| **Area of Mitigation** | 0.33 ha (0.82 ac) |

**Table 3.2 Monitoring and Management Summary from the SR 7 Nisqually Slough Mitigation Site**

| Performance Criteria | 2002 Results[12] | Management Activities |
|---|---|---|
| 1. 100% survival in the wetland | 97% (total count) | Replanted in early spring 2002 |
| 2. Wetland hydrology | Present | |
| 3. $\leq$ 20% cover by invasives | Wetland: 0.8% ($CI_{80\%}$ = 0-2% cover)<br>Upland 11.5% ($CI_{90\%}$ = 9-14% cover) | Weed control |
| 4. 100% survival in the upland buffer | 94% (total count) | Replanted in early spring 2002 |
| 5. 20% cover by trees and 30% cover by shrubs in all areas | <5% (qualitative) | |

[12] Estimated values are presented with their corresponding statistical confidence interval. For example, 0.8% ($CI_{80\%}$ = 0-2% cover) means we are 80% confident that the true aerial cover value is between 0% and 2%.

## Success Standards and Sampling Objectives

First year success standards for the SR 7 Nisqually Slough mitigation site were excerpted from the *SR 7 MP 40 to MP 42.5 Wetland Mitigation Plan* (Russell 1999). Companion sampling objectives follow the success standards where appropriate. Appendix B provides the complete text of the success standards for this project.

Success Standard 1
100 percent survival (or replacement) of trees and shrub species in the wetland at the end of year one (2002).

Success Standard 2
Hydrology (within 12 inches of the soil surface) within the wetland creation area must be present for at least 12.5% of the growing season (2002).

Success Standard 3
Cover of reed canarygrass, or other invasive species may not exceed 20 percent of the total wetland area at any time during years one through five.

> Sampling Objective 3
> To be 80% confident the true aerial cover by invasive species is within 20% of the estimated survival value in 2002.

Success Standard 4
100 percent survival (or replacement) of trees and shrub species in the buffer at the end of year one (2002).

Success Standard 5
Vegetative cover in all areas (as applicable) shall be trees 20%, shrubs 30% in year 1 (2002).

## Methods

To address survival for Success Standards 1 and 4, a total count of woody plantings was conducted by zone. Planted individuals were identified and recorded as alive, stressed, or dead.

To address Standard 2, wetland hydrology field indicators were recorded during site visits in April, May, and July 2002.

To address cover by invasive species (Success Standard 3), 28 temporary transects were placed perpendicular to a baseline using a systematic random sampling method (Figure 3.1). Thirty-five point-line sample units were randomly located along sampling transects. Sample unit lengths ranged from 18 to 21 m, and data were collected at quarter meter intervals.

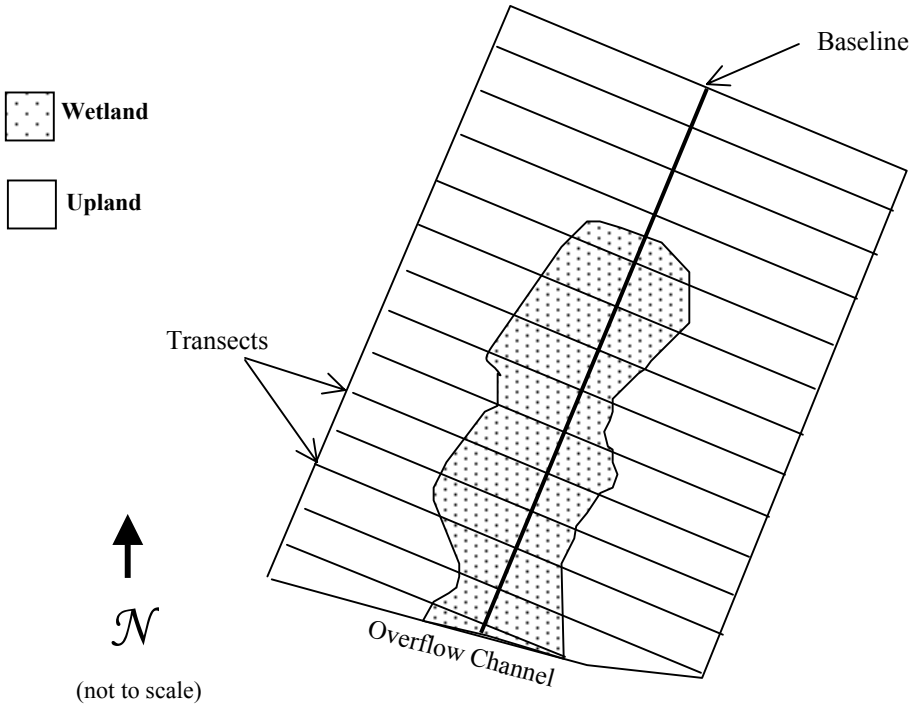



**Figure 3.1 SR 7 Nisqually Slough Mitigation Site Sampling Design (2002)**

Sample size analysis confirmed that sufficient sampling had been completed based on the sampling objective and the desired level of statistical confidence. The following sample size equation was used to perform this analysis.

$$n = \frac{(z)^2(s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[13]
n = unadjusted sample size

Since the site was planted in the spring of 2002, a qualitative ocular estimate was generated to address aerial cover by trees and shrubs in all areas (Success Standard 5).

Three bird surveys were conducted between mid-May and early July to be used primarily for future evaluation of wildlife use over time. Species richness and relative abundance were recorded.

Incidental wildlife observations were also recorded.

[13] The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

For additional details on the methods described above, see the Methods section of this report.

**Results and Discussion**

Success Standard 1 – 100% Survival in the Wetland Zone
Based on a total count, survival of planted woody species was 97% in the wetland. Of the 775 individuals observed in the wetland, 26 were dead. Native volunteer *Alnus rubra* (red alder), *Symphoricarpos albus* (common snowberry) and *Salix* spp. (willows) were included in this count (Figure 3.2).

**Figure 3.2 SR 7 Nisqually Slough (July 2002)**

Success Standard 2 – Wetland Hydrology
Observations of inundation and saturation to the surface in early April and mid-May, suggests that the wetland area was saturated to the surface consecutively for more than two weeks during the growing season. This meets the hydrology field indicator for jurisdictional wetlands (Environmental Laboratory 1987).

Success Standard 3 – Less Than 20% Cover by Invasive Species
Invasive species including *Phalaris arundinacea* (reed canarygrass), *Cytisus scoparius* (scotchbroom) and *Hypochaeris radicata* (hairy catsear) provide an estimated aerial cover of 2% ($CI_{80\%}$ = 0-4% cover) in the wetland area. Living mature *P. arundinacea* were not observed in areas that had received weed control. Weed control performed through the time of monitoring appears to be sufficient to meet this standard.

In the upland, aerial cover provided by invasive species was estimated to be 12% ($CI_{90\%}$ = 9-14% aerial cover). Invasive species observed in this area include:

- *P. arundinacea*
- *C. scoparius*
- *H. radicata* (hairy catsear)
- *Cirsium vulgare* (bull thistle)
- *Cirsium arvense* (Canada thistle)
- *Leucanthemum vulgare* (oxeye daisy)
- *Hypericum perforatum* (common St. Johnswort).

High densities of young (≤ 0.5 meters) *C. scoparius* appeared to be the most common invasive species across large areas of the planted upland zone. The *C. scoparius* was generally taller than all other species in these areas. Although cover by invasive species is currently below the 20% threshold, these species may have an impact on future survival of plantings in the upland.

Success Standard 4 – 100% Survival in the Upland Zone
Based on a total count, survival of planted woody species was 94%. The count included volunteer *A. rubra* and *S. albus*. Of the 862 individuals observed in the upland, 50 were dead.

Success Standard 5 – At Least 20% Cover by Trees and 30% Cover by Shrubs
An ocular estimate of aerial cover by woody species in the combined wetland and upland zones was less than 5%. This value is reasonable given the stem density at installation and the short time interval between plant installation and monitoring. Future standards addressing cover may still be met, given normal growth conditions.

One of the general goals of the wetland mitigation is to provide wildlife habitat (Appendix B). Bird surveys were conducted to provide evidence of wildlife use. Twenty-three species (15 families) including 4 wetland-dependent and 1 wetland-associated species were observed during bird surveys (Table 3.3).[14]

**Table 3.3 SR 7 Nisqually Slough Mitigation Site Bird Status**

| Common Name | Scientific Name | Status |
|---|---|---|
| Common Yellowthroat | *Geothlypis trichas* | Wetland-dependent |
| Great Blue Heron | *Ardea herodias* | Wetland-dependent |
| Mallard | *Anas platyrhynchos* | Wetland-dependent |
| Red-winged Blackbird | *Agelaius phoeniceus* | Wetland-dependent |
| Warbling Vireo | *Vireo gilvus* | Wetland-associated |

## Management Activities

Plant installation was completed in the spring of 2002. Subsequent management activities include ongoing weed control measures to control *P. arundinacea*, *Cirsium* species, and *C. scoparius* by mechanical methods (brush cutting and hand pulling). Supplemental watering was performed as necessary. Additional re-vegetation, seeding, and aquatic herbicide applications are scheduled for the fall/winter 2002.

[14] Birds are assigned an upland or wetland-dependent species status based on the classification scheme presented in Brown and Smith (1998). Regional variation occurs. Additional references used to further classify bird species include Thomas (1979), Ehrlich et al. (1988), and Smith et al. (1997).

# SR 161 Kapowsin, Pierce County

The following report summarizes monitoring activities completed by the Washington State Department of Transportation Wetland Monitoring Program at the SR 161 Kapowsin mitigation site in July 2002. Monitoring data were obtained to address first year success standards. Activities included vegetation and wildlife surveys. Table 4.1 provides general site information and Table 4.2 shows this year's monitoring results.

**Table 4.1 General Site Information for the SR 161 Kapowsin Mitigation Site**

| | | |
|---|---|---|
| **Project Name** | MP 13 to MP 14 Safety Improvement (Junction Kapowsin Highway) | |
| **USACE Permit Number** | 93-4-01100 | |
| **Mitigation Location** | West side of SR 161 just South of the SR 161 / South Fork Muck Creek crossing | |
| **Township/Range/Section (impact)** | T.17N/R.04E/S.09 | |
| **Monitoring Period** | 2002 to 2006 | |
| **Year of Monitoring** | 1 of 5 | |
| **Area of Project Impact** | 0.07 ha (0.16 ac) | |
| **Type of Mitigation** | Wetland creation/Enhancement/Total | Buffer Enhancement |
| **Area of Mitigation** | 0.06 ha (0.16 ac)/0.06 ha (0.16 ac)/0.12 ha (0.32 ac) | 0.12 ha (0.32 ac) |

**Table 4.2 Monitoring Results from the SR 161 Kapowsin Mitigation Site**

| Performance Criteria | 2002 Results[15] | Management Activities |
|---|---|---|
| 1. 100% survival (or replacement of trees shrubs and herbaceous plants after one year) | 95% (total count) | Replanting, mulch rings, fertilizer, supplemental watering, deer guards (spring 2002) |
| 2. $\geq$ 30% FAC and wetter aerial cover on site | 94% ($CI_{95\%}$ = 91-97% cover) | |
| 3. $\leq$ 20% aerial cover of invasive species in the wetland area | 14% ($CI_{80\%}$ = 11-17% cover) | Weeding, mulching around plantings (spring 2002) |
| 4. Hydrology within the wetland creation area present for 12.5% of the growing season | Yes | |

[15] Estimated values are presented with their corresponding statistical confidence interval. For example, 94% ($CI_{94\%}$ = 91 – 97% aerial cover) means we are 95% confident that the true aerial cover value is between 91% and 97%.

**Success Standards and Sampling Objectives**

First year success standards for the SR 161 Kapowsin mitigation site were excerpted from the *MP 13 to MP 14 Safety Improvements Junction Kapowsin Highway Vicinity SR 161 Wetland Mitigation Plan* (Russell 1998). Sampling objectives follow the success standard where appropriate. Appendix C presents the complete text of the success standards for this project.

Success Standard 1
100% survival (or replacement) of trees, shrubs, and emergent species at the end of year one. Non-invasive volunteer species are acceptable in all zones and may be used in estimating percent cover of emergent species and credited toward survival of planted trees and shrubs.

Success Standard 2
A minimum of 30% emergent vegetation on site in year one (2002).

> Sampling Objective
> To be 80% confident that the true aerial cover value of FAC and wetter species on site is within 20% of the estimated value.

Success Standard 3
Cover of reed canarygrass, or other invasive species may not exceed 20 percent of the total wetland area at any time during years one through five (2002).

> Sampling Objective
> To be 80% confident the true aerial cover value of invasive species on site is within 20% of the estimated value.

Success Standard 4
Hydrology (within 12 inches of the soil surface) within the wetland creation area must be present for at least 12.5% of the growing season (2002).

**Methods**

To evaluate the survival of planted trees and shrubs on the mitigation site (Success Standard 1), a total count was conducted. Plantings were recorded as alive, dead, or stressed. To determine overall survival, the total number of living and stressed plantings was divided by the total number of plantings present on the site. Reliable methods for conducting accurate quantitative assessments of herbaceous plantings are not available; therefore, a qualitative assessment of the herbaceous community was conducted.

Cover of facultative and wetter vegetation (Success Standard 2) was assessed using the point-intercept method. Nineteen temporary sampling transects were placed perpendicular to a baseline using a systematic random sampling method. Thirty 20m

sample units (40 points each) were randomly positioned along sampling transects (Figure 4.1).

The point intercept method was also used to evaluate invasive cover (Success Standard 3). Twenty-nine transects were located along the baseline using a systematic random sampling method. Data were collected on forty-six 20m sample units (40 points each) along sampling transects (Figure 4.1).

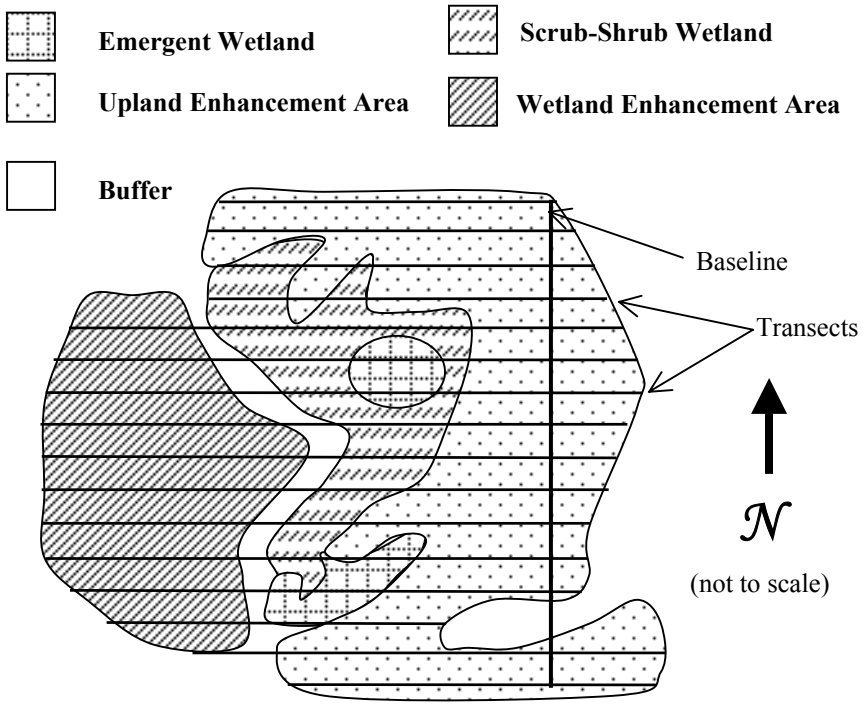



**Figure 4.1 SR 161 Kapowsin Mitigation Site Sampling Design (2002)**

Sample size analysis confirmed that sufficient sampling had been completed based on the sampling objective and the desired level of statistical confidence. The following sample size equation was used to perform this analysis on the collected data.

$$n = \frac{(z)^2 (s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[16]
n = unadjusted sample size

To evaluate the hydrology standard, qualitative observations were made on April 3rd and May 22nd 2002.

16 The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

Four bird surveys were conducted between mid-May and early July to be used primarily for future evaluation of wildlife use over time. Species richness and relative abundance were recorded.

Incidental wildlife observations were also recorded.

For additional details on the methods described above, see the Methods section of this report.

**Results and Discussion**

Success Standard 1 - 100% Survival (or Replacement) of Trees and Shrubs at the End of Year One

In 2002, the mean survival of planted woody species was 95%. This is below the 100% survival requirement, so replanting will be necessary to meet the standard. Figure 4.2 shows some of the woody plantings.

**Figure 4.2 SR 161 Kapowsin Mitigation Site (July 2002)**

Success Standard 2 – At Least 30% Aerial Cover of FAC and Wetter Vegetation

The aerial cover of FAC and wetter woody and herbaceous vegetation on the mitigation site was estimated to be 94% ($CI_{95\%}$ = 91 - 97% cover). This is above the 30% aerial cover requirement for year one. Table 4.4 provides a list of the FAC and wetter species that were observed on the mitigation site.

Success Standard 3 – No More Than 20% Cover of Invasive Species in the Wetland Area

The aerial cover of invasive species in the wetland area was estimated to be 14% ($CI_{80\%}$ = 11 - 17% cover). Although the estimate is below the 20% cover requirement, continued weed control may be required to keep the cover below 20% throughout the monitoring period (2002-2006). The main species of concern include *Phalaris arundinacea* (reed canarygrass), *Cirsium* species (thistles), and *Rubus* species (blackberries).

Success Standard 4 – Hydrology within the wetland creation area present for 12.5% of the growing season

Hydrological conditions on site appear to be developing as intended. In early April and the end of May, the soil was saturated to the surface throughout the wetland areas. There were small areas of shallow inundation with up to a decimeter of water present during

each of these visits. These observations suggest that hydrology is present for a duration that achieves the prescribed criteria.

One of the general goals of the wetland mitigation is to provide wildlife habitat. Bird surveys were conducted to provide evidence of wildlife use. Twenty-four species (14 families) including one wetland-dependent and 4 wetland-associated species were observed during bird surveys (Table 3.3).

**Table 4.3 SR 161 Kapowsin Mitigation Site Bird Status**

| Common Name | Scientific Name | Status[17] |
|---|---|---|
| Common Yellowthroat | *Geothlypis trichas* | Wetland-dependent |
| Barn Swallow | *Hirundo rustica* | Wetland-associated |
| Black-capped chickadee | *Parus atricapillus* | Wetland-associated |
| Willow Flycatcher | *Empidonax traillii* | Wetland-associated |
| Wilson's Warbler | *Wilsonia pusilla* | Wetland-associated |

## Management Activities

In 2002, the Olympic Region performed the following management activities:

- Weed control measures were implemented to control blackberries, thistle species, and scotch broom.
- Replanted in early spring to ensure all plants were installed and alive per the planting plan requirements.
- Installed bark mulch rings around plants. Fertilized plants with slow release fertilizer.
- Supplemental watering was performed as needed.
- Deer guards were placed on conifers to minimize browsing damage.

[17] Birds are assigned an upland or wetland-dependent species status based on the classification scheme presented in Brown and Smith (1998). Regional variation occurs. Additional references used to further classify bird species include Thomas (1979), Ehrlich et al. (1988), and Smith et al. (1997).

# SR 509 Hylebos, Pierce County

The following report summarizes monitoring activities completed by the Washington State Department of Transportation Wetland Monitoring Program at the SR 509 Hylebos mitigation site in August 2002. Monitoring data were obtained to compare to fifth year success standards and a permit requirement.[18] Activities included vegetation surveys of the emergent wetland and the tree and shrub planting areas. Table 5.1 provides general site information and Table 5.2 summarizes this year's monitoring results for the SR 509 Hylebos mitigation site.

**Table 5.1 General Site Information for the SR 509 Hylebos Creek Mitigation Site**

| | |
|---|---|
| **Project Name** | SR 509 East-West Corridor |
| **USACE Permit Number** | 93-4-00148 |
| **Mitigation Location** | Southeast of SR 509, northeast of Taylor Way, Pierce County |
| **Township/Range/Section (Impact)** | T.20N/R.35E/S.2 |
| **Monitoring Period** | 1996-2004 |
| **Year of Monitoring** | 7 of 9 |
| **Area of Project Impact**[19] | 0.52 ha (1.27 ac) |
| **Type of Mitigation** | Creation/Restoration |
| **Area of Mitigation** | 0.78 ha (1.93 ac) |

**Table 5.2 Monitoring and Management Summary from the SR 509 Hylebos Creek Mitigation Site**

| Performance Criteria | 2002 Results[20] | Management Activities |
|---|---|---|
| **Success Standards** | | |
| 1. $\geq$ 80% aerial cover of planted woody vegetation in woody planted areas | 57% ($CI_{90\%}$ = 52-63% cover) | |
| 2. $\geq$ 50% aerial cover of native FAC and wetter species in the emergent wetland | 34% ($CI_{90\%}$ = 28-40% cover) | |
| 3. Presence of wetland-associated or -dependent species | Yes | |
| **Permit Requirement** | | |
| 4. $\leq$ 10% aerial cover of non-native invasive species in the wetland | 16% ($CI_{80\%}$ = 12-20% cover) | Weed control |

[18] The USACE Permit # 93-4-00148 requires monitoring for nine years. Fifth year success standards from the *SR 509 East-West Corridor Wetland Mitigation Plan* are assumed to apply to the last year of monitoring.

[19] Two mitigation sites (SR 509 Erdahl Ditch and SR 509 Hylebos) provide compensation for impacts from the SR 509 East-West Corridor project.

[20] Estimated values are presented with their corresponding statistical confidence interval. For example, 57% ($CI_{90\%}$ = 52-63% cover) means we are 90% confident that the true aerial cover value is between 52% and 63%.

**Success Standards and Sampling Objectives**

Fifth year success standards and requirements for the SR 509 Hylebos mitigation site were excerpted from the *SR 509 East-West Corridor Wetland Mitigation Plan* (WSDOT 1994) and *Department of Army Permit 93-4-00148* (USACE 1994). These are assumed to apply to the end of the monitoring period (2004) as specified in the USACE permit. Success standards below were evaluated in 2002 for potential mid-course corrections prior to final year monitoring in 2004. Sampling objectives follow the success standard and permit requirement where appropriate. Appendix D provides the complete text of the success standards and an additional permit requirement for this project.

Success Standard 1
At the end of the monitoring period, the shrub and tree planted areas of the Hylebos site will have a minimum of 80% average areal (*sic*) cover that are appropriate to the site and to its hydrologic regime (2004).

> Sampling Objective 1
> To be 80% confident the true aerial cover of woody vegetation in the shrub and tree planted areas is within 20% of the estimated value in 2002.

Success Standard 2
The Hylebos mitigation site Lyngby's sedge planting area should have 50% areal (*sic*) coverage of native wetland species at the end of the monitoring period (2004).

> Sampling Objective 2
> To be 80% confident the true aerial cover by native FAC and wetter species in the emergent zone is within 20% of the estimated value in 2002.

Success Standard 3
Development of habitat diversity and structure will be determined by the diversity and numbers of wetland dependent species identified during the wetland mitigation monitoring program. The sites will meet this objective if wildlife species that utilize wetlands for some or all of their habitat requirements are located (2004).

Permit Requirement 4
At the end of the monitoring period, the Hylebos Creek mitigation wetland shall include no more than 10% areal (*sic*) cover by non-native, invasive species (2004).

> Sampling Objective
> To be 80% confident the true aerial cover by non-native, invasive species on the entire site is within 20% of the estimated value in 2002.

## Methods

To evaluate aerial cover of both woody and herbaceous vegetation, 36 temporary transects were placed using the systematic random sampling method along a baseline on the west side of the site (Figure 5.1). Temporary transects were placed perpendicular to the baseline in the mitigation site areas north of Hylebos Creek. South of Hylebos Creek, transects were placed radiating out from the baseline. The preserved vegetation areas were not monitored.

To address Success Standard 1, woody species cover data were collected in the tree and shrub planting areas using the line-intercept method. Data were collected on 168 line-segment sample units 3 m in length, randomly located along sampling transects.

Native FAC and wetter vegetation (Success Standard 2) was addressed using the point-line method in the wetland zone. Thirty-one point-line sample units with a length ranging from 17 to 20 m were randomly located along sampling transects. Data were obtained at 170 to 200 point locations on each sample unit.

The point-line method was also used to evaluate cover of invasive species (Permit Requirement 4). Fifty-seven point-line sample units with a length ranging from 18 to 20m were randomly located along sampling transects. Data were obtained at 72 to 80 point locations on each sample unit.

The following sample size equation was used to perform this analysis on the collected data.

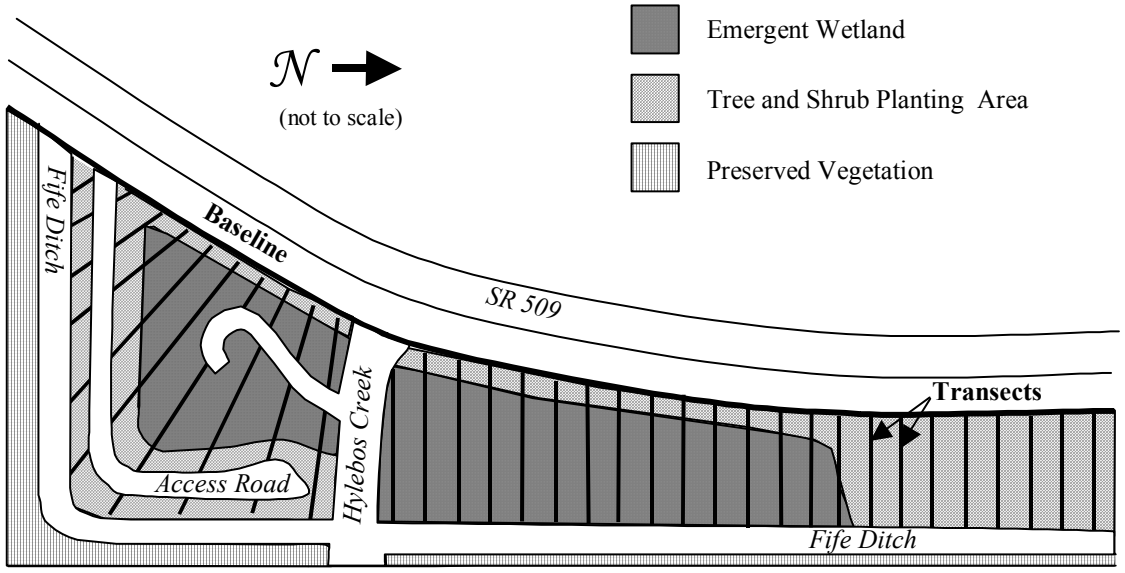



**Figure 5.1 SR 509 Hylebos Mitigation Site Sampling Design (2002)**

$$n = \frac{(z)^2 (s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[21]
n = unadjusted sample size

Four bird surveys were conducted between mid-May and early-July to address Success Standard 3. Species richness and relative abundance were recorded. Species diversity indices (H′) were calculated from bird survey data using the Shannon-Wiener function (Krebs 1999). A mean species diversity index was calculated for 2002.

$$H' = -\sum_{i=1}^{s} (p_i)(\log p_i)$$

$H'$ = index of species diversity
$s$ = number of species
$p_i$ = proportion of sample belonging to $i$th species

To determine if an increase in bird diversity occurred from 2000 to 2002, a one-tailed t-test ($\alpha = 0.025$) was performed between the species diversity indices of each year.

For additional details on the methods described above, see the Methods section of this report.

**Results and Discussion**

Success Standard 1 – At Least 80% Cover by Woody Species in the Shrub and Tree Planted Areas

Aerial cover provided by planted woody species was estimated at 57% ($CI_{90\%}$ = 52-63% cover). This value approaches the final year Success Standard 1. With continued growth and development, this standard may be met by 2004. Areas adversely affected by invasive species will be revegetated in late winter/early spring of 2003.

**Figure 5.2 SR 509 Hylebos Mitigation Site Emergent Wetland**

[21] The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

Success Standard 2 – At Least 50% Cover by Native, FAC and Wetter Species in the Emergent Zone

Aerial cover provided by facultative and wetter herbaceous species was estimated at 34% ($CI_{90\%}$ = 28-40%) in the emergent zone (Figure 5.2). Although this value does not meet the final year Success Standard 2, the site may achieve the desired aerial cover by 2004. A list of species observed in this zone is included in Table 5.3.

**Table 5.3 Native Wetland Plants Observed in the Wetland at the SR 509 Hylebos Creek Site**

| Scientific Name | Common Name | Indicator Status[22] |
|---|---|---|
| *Eleocharis parvula* | dwarf spikerush | OBL |
| *Eleocharis palustris* | common spikerush | OBL |
| *Deschampsia cespitosa* | tufted hairgrass | FACW |
| *Symphyotrichum subspicatum* | Douglas aster | FACW |
| *Carex lyngbyei* | Lyngbye's sedge | OBL |
| *Juncus effusus* | soft rush | FACW |
| *Salicornia virginica* | pickleweed | OBL |

Success Standard 3 – Presence of Wetland-dependent and Wetland-associated Wildlife

Success Standard 3 states that development of habitat diversity and structure will be determined by the diversity and numbers of wetland-dependent and wetland-associated wildlife species identified during mitigation monitoring. Bird surveys were conducted each year to document the species and families that are present on site during the monitoring period. Table 5.4 shows the survey results for the past 3 years.[23] Although the diversity indices have not yet indicated a statistically significant increase in diversity on site, this data will continue to be used as a baseline for future comparisons.

**Table 5.4 SR 509 Hylebos Creek Mitigation Site Bird Survey Results**

| Attribute | Year 2000 | Year 2001 | Year 2002 |
|---|---|---|---|
| Mean Species Richness | 10 | 10 | 9 |
| Mean Family Richness | 8 | 7 | 8 |
| Species Diversity Index | | | |
| Mean H' | 0.78 | 0.92 | 0.87 |
| Standard Error | 0.12 | 0.04 | 0.07 |
| Range | 0.43 – 0.91 | 0.87 – 1.00 | 0.68 – 0.98 |

A total of 41 bird species from 19 avian families were observed on the site from 1996 to 2002. Of the 41 bird species, 16 are wetland-dependent and 8 are wetland-associated (Table 5.5). The presence of wetland-associated and wetland-dependent bird species at the site meets the criteria of Success Standard 3.

[22] Hydrophytic plant indicator status was obtained from the *National List of Plant Species that Occur in Wetlands: Northwest* (Reed 1988 and 1993).

[23] Statistical analysis was performed using data gathered in years 2000-2002.

**Table 5.5 SR 509 Hylebos Creek Mitigation Site Bird Status**

| Common Name | Scientific Name | Status[24] |
|---|---|---|
| American Wigeon | *Anas americana* | Wetland-dependent |
| Belted Kingfisher | *Ceryle alcyon* | Wetland-dependent |
| Canada Goose | *Branta canadensis* | Wetland-dependent |
| Cinnamon Teal | *Anas cyanoptera* | Wetland-dependent |
| Common Yellowthroat | *Geothlypis trichas* | Wetland-dependent |
| Great Blue Heron | *Ardea herodias* | Wetland-dependent |
| Green Heron | *Butorides striatus* | Wetland-dependent |
| Green-winged Teal | *Anas crecca* | Wetland-dependent |
| Least Sandpiper | *Calidris minutilla* | Wetland-dependent |
| Lesser Yellowlegs | *Tringa flavipes* | Wetland-dependent |
| Mallard | *Anas platyrhynchos* | Wetland-dependent |
| Marsh Wren | *Cistothorus palustris* | Wetland-dependent |
| Red-breasted Merganser | *Mergus serrator* | Wetland-dependent |
| Sanderling | *Calidris alba* | Wetland-dependent |
| Spotted Sandpiper | *Actitis macularia* | Wetland-dependent |
| Wood Duck | *Aix sponsa* | Wetland-dependent |
| Barn Swallow | *Hirundo rustica* | Wetland-associated |
| Black-capped Chickadee | *Parus atricapillus* | Wetland-associated |
| Glaucous-winged Gull | *Larus glaucescens* | Wetland-associated |
| Killdeer | *Charadrius vociferus* | Wetland-associated |
| Northern Rough-winged Swallow | *Stelgidopteryx serripennis* | Wetland-associated |
| Tree Swallow | *Tachycineta bicolor* | Wetland-associated |
| Violet-green Swallow | *Tachycineta thalassina* | Wetland-associated |
| Wilson's Warbler | *Wilsonia pusilla* | Wetland-associated |

Permit Requirement 4– No More than 10% Aerial Cover by Non-Native Invasive Species

The estimated aerial cover provided by non-native invasive species is 16% ($CI_{80\%}$ = 12-20% cover). Despite weed control, this value exceeds the limit for aerial cover by non-native invasive species. Non-native invasive species observed on the site included the following:

- *Cirsium arvense* (Canada thistle)
- *Cirsium vulgare* (bull thistle)
- *Cytisus scoparius* (scotchbroom)
- *Hypericum perforatum* (common St. Johnswort)
- *Hypochaeris radicata* (hairy catsear)
- *Phalaris arundinacea* (reed canarygrass)
- *Phragmites australis* (common reed)
- *Rubus armeniacus* (Himalayan blackberry)
- *Sonchus arvensis* (field sowthistle)
- *Tanacetum vulgare* (common tansy)

[24] Birds are assigned an upland or wetland-dependent species status based on the classification scheme presented in Brown and Smith (1998). Regional variation occurs. Additional references used to further classify bird species include Thomas (1979), Ehrlich et al. (1988), and Smith et al. (1997).

## Management Activities

Table 5.6 provides a summary of past management activities.

**Table 5.6 Summary of Management Activities at the SR 509 Hylebos Mitigation Site**

| Date | Description of Management Activities |
|---|---|
| Winter 2002/2003 | Re-planted and performed weed control measures. |
| Summer 2002 | Invasive species control - mechanical methods and herbicide application. |
| 2001 | Invasive species control - mechanical methods and herbicide application. |
| 2000 | Re-planted and performed weed control measures. |
| 1999 | Invasive species control - mechanical methods and herbicide application |
| 1998 | Re-planted and performed weed control measures. |
| 1997 | Re-planted and performed weed control measures. |
| 1996 | Re-planted and performed weed control measures. |

# SR 509 Erdahl Ditch, Pierce County

The following report summarizes monitoring activities completed by the Washington State Department of Transportation Wetland Monitoring Program at the SR 509 Erdahl Ditch mitigation site in July 2002. Monitoring data were obtained to compare to fifth year success standards and permit requirements.[25] Activities include vegetation surveys of the buffer and wetland plant communities. Table 6.1 provides general site information and Table 6.2 summarizes this year's monitoring results for SR 509 Erdahl Ditch.

**Table 6.1 General Site Information for the SR 509 Erdahl Ditch Mitigation Site**

| | |
|---|---|
| **Site Name** | SR 509 East-West Corridor |
| **USACE Permit Number** | 93-4-00148 |
| **Location** | I/C SR 509 and Port of Tacoma Road, Pierce County |
| **Township/Range/Section/** | T.20N/R.35E/S.2 |
| **Monitoring Period** | 1996 to 2004 |
| **Year of Monitoring** | 7 of 9 |
| **Area of Project Impact**[26] | 0.52 ha (1.27 ac) |
| **Type of Mitigation** | Ditch Relocation |
| **Area of Mitigation** | 0.18 ha (0.44 ac) |

**Table 6.2 Monitoring and Management Summary from the SR 509 Erdahl Ditch Mitigation Site**

| Performance Criteria | 2002 Results[27] | Management Activities |
|---|---|---|
| **Success Standards** | | |
| 1. ≥ 90% aerial cover of FAC+ or wetter species in the wetland | 95% ($CI_{80\%}$ = 56-100% cover) | |
| 2. ≥ 90% aerial cover of vegetation in the wetland | 97% ($CI_{80\%}$ = 68-100% cover) | |
| 3. ≥ 80% aerial cover of woody species in the buffer | 91% ($CI_{90\%}$ = 89-93% cover) | |
| 4. Presence of wetland dependent species | Yes | |
| **Permit Requirement** | | |
| 5. ≤ 10% aerial cover of non-native invasive species | 20% ($CI_{80\%}$ = 16-24% cover) | Weed control |

[25] The USACE Permit # 93-4-00148 requires monitoring for nine years. Fifth year success standards from the *SR 509 East-West Corridor Wetland Mitigation Plan* are assumed to apply to the last year of monitoring.

[26] Two mitigation sites (SR 509 Erdahl ditch and SR 509 Hylebos) provide compensation for impacts from the SR 509 East-West Corridor project.

[27] Estimated values are presented with their corresponding statistical confidence interval. For example, 95% ($CI_{80\%}$ = 56 -100% cover) means we are 80% confident that the true aerial cover value is between 56% and 100%.

**Success Standards, Permit Requirement and Sampling Objectives**

Fifth year success standards and requirements for the SR 509 Erdahl Ditch mitigation site were excerpted from the *SR 509 East-West Corridor Wetland Mitigation Plan* (WSDOT 1994) and *Department of Army Permit (USACE 1994)*. These are assumed to apply to the end of the monitoring period as specified in USACE permit 93-4-00148 (2004). Sampling objectives follow the success standard and permit requirement where appropriate. Appendix D provides the complete text of the success standards and an additional permit requirement for this project.

Success Standard 1
The Erdahl Ditch wetland seeding area should have a minimum of 90% areal (*sic*) coverage of wetland species (FAC+ or wetter) (2004).

> Sampling Objective 1
> To be 80% confident the true aerial cover of the FAC+ and wetter species is within 20% of the estimated cover value in 2002.

Success Standard 2
Dense vegetation establishment in the wetland (≥90% areal (*sic*) coverage) within the monitoring period (2004).

> Sampling Objective 2
> To be 80% confident the true aerial cover of vegetation is within 20% of the estimated cover value in 2002.

Success Standard 3
At the end of the monitoring period (2004), the shrub and tree planted areas of Erdahl Ditch will have a minimum of 80% average areal (*sic*) cover that is appropriate to the site and to its hydrologic regime.

> Sampling Objective 3
> To be 80% confident the true aerial cover of woody vegetation is with 20% of the estimated cover value in 2002.

Success Standard 4
Dense buffer vegetation (greater than 80% areal (*sic*) coverage) (2004).

> Sampling Objective 4
> To be 80% confident the true aerial cover of the buffer vegetation is within 20% of the estimated cover value in 2002.

Success Standard 5
Development of habitat diversity and structure will be determined by the diversity and numbers of wetland dependent species identified during the wetland mitigation monitoring program. The sites will meet this objective if wildlife species that utilize wetlands for some or all of their habitat requirements are located (2004).

Permit Requirement
The Erdahl Ditch Tributary replacement wetland shall include no more than 10% areal (*sic*) cover by non-native, invasive species (2004).

Sampling Objective
To be 80% confident the true aerial cover of non-native, invasive species is within 20% of the estimated cover value in 2002.

## Methods

To evaluate aerial cover of woody and herbaceous vegetation, 29 temporary transects were placed perpendicular to a baseline using a systematic random sampling method (Figure 6.1).

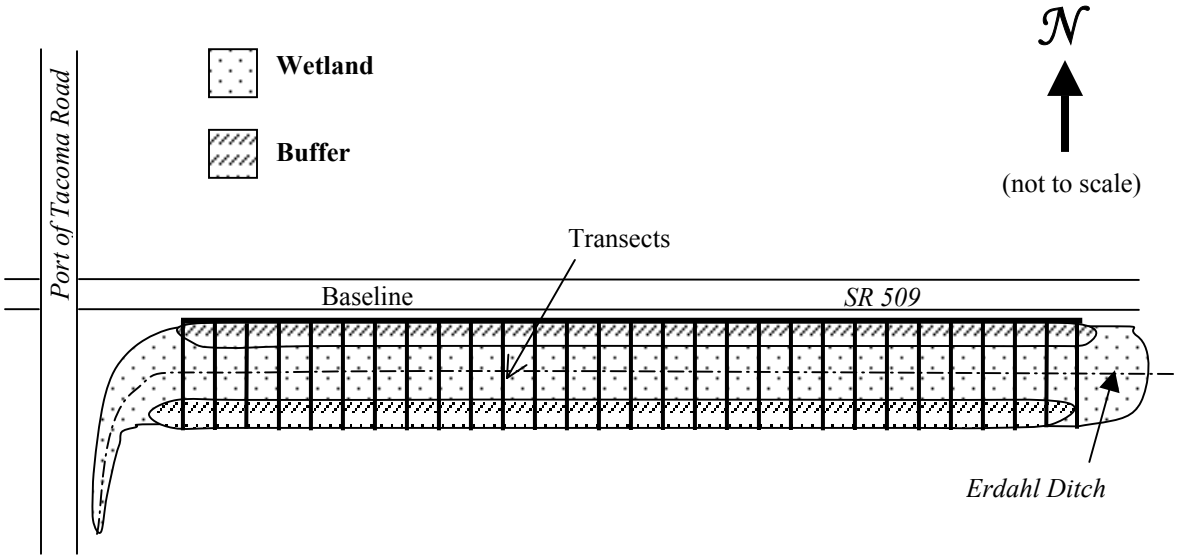



**Figure 6.1 SR 509 Erdahl Ditch Mitigation Site Sampling Design (2002)**

Aerial cover of vegetation in the wetland (Success Standards 1 and 2) was addressed using the line-intercept method. A 5.6 meter point-line sample unit was randomly located along every sampling transect.

To address Success Standards 3 and 4, tree and shrub species cover data were also collected using the line-intercept method in the buffer area. Data were collected on 29 line-segment sample units that had a length of 10.1 m each. Sample units were randomly located along every sampling transect.

The point-line method was used to evaluate cover of invasive species (Permit). A sample unit was randomly located along each transect and had a length that ranged from 15.2 to 18.6 meters. Data were collected at quarter meter intervals.

Sample size analysis was conducted using the following equation.

$$n = \frac{(z)^2 (s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[28]
n = unadjusted sample size

Four bird surveys were conducted between mid-May and mid-July to address Success Standard 5. Species richness and relative abundance were recorded.

Species diversity indices (H) were calculated from bird survey data using the Shannon-Wiener function (Krebs 1999). A mean species diversity index was calculated for 2002.

$$H' = -\sum_{i=1}^{s} (p_i)(\log p_i)$$

$H'$ = index of species diversity
$s$ = number of species
$p_i$ = proportion of sample belonging to $i$th species

To determine if an increase in bird diversity occurred from 2000 to 2002, a one-tailed t-test ($\alpha = 0.025$) was performed between the species diversity indices of both years.

For additional details on the methods described above, see the Methods section of this report.

**Results and Discussion**

Currently, woody species planted in the buffer have developed so robustly that a nearly closed canopy has been created over sparse herbaceous species in the wetland (Figure 6.2). Succession has occurred, reducing the herbaceous cover in the wetland and making trees and shrubs the dominant vegetation on the mitigation site. *Salix lucida* (Pacific willow) (FACW+) provides most of the aerial cover in the wetland.

**Figure 6.2 SR 509 Erdahl Ditch Mitigation Site (July 2002)**

[28] The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

Success Standard 1 – 90% Aerial Cover by FAC+ and Wetter Species in the Wetland
The aerial cover of facultative and wetter species in the wetland is estimated to be 95% ($CI_{80\%}$ = 56-100% cover). This value exceeds the 90% aerial cover requirement. *Salix lucida* (Pacific willow) (FACW+) provides most of this cover.

Success Standard 2 – At Least 90% Aerial Cover by Vegetation in the Wetland
The total vegetative aerial cover was estimated to be 97% ($CI_{80\%}$ = 68-100% cover). This exceeds the 90% cover requirement.

Success Standards 3 and 4 – At Least 80% Aerial Cover of Woody Species in the Shrub and Tree Planted Areas (Buffer)
Woody species in the buffer provide an estimated 91% aerial cover ($CI_{90\%}$ = 89-93% cover). This value exceeds the final year requirement of 80% cover. Overall, the buffer continues to develop as intended with dense native woody species.

Success Standard 5 – Presence of Wetland-Dependent Wildlife Species
Success Standard 5 states that development of habitat diversity and structure will be determined by the diversity and numbers of wetland-dependent wildlife species identified during monitoring. Bird surveys were conducted each year to document species richness and calculate diversity indices. Although the diversity indices have not yet indicated a statistically significant increase in diversity on site, this data will continue to be used as a baseline for future comparisons. Table 6.3 shows species richness data for the last 3 years.[29]

**Table 6.3 SR 509 Erdahl Ditch Mitigation Site Bird Survey Results**

| Attribute | Year 2000 | Year 2001 | Year 2002 |
|---|---|---|---|
| Mean Species Richness | 24 | 13 | 16 |
| Mean Family Richness | 12 | 9 | 12 |
| Species Diversity Index | | | |
| Mean | 0.9345 | 0.7421 | 0.8692 |
| Standard Error | 0.0565 | 0.0970 | 0.1270 |
| Range | 0.8262-1.0168 | 0.5494-0.8584 | 0.5215-1.1106 |

Although bird surveys were difficult to conduct due to ongoing construction and high-speed traffic adjacent to the site, a total of 29 bird species from 15 avian families were observed on the site from 2000 to 2002. Four of the 29 bird species are wetland-dependent and one is wetland associated (Table 6.4). In addition, Song Sparrows (*Melospiza melodia*) and Downy Woodpeckers (*Picoides pubescens*) were observed nesting in the wetland areas. This suggests that the site is providing sufficient wildlife habitat to meet Success Standard 5.

[29] Statistical analysis was performed using data gathered in year 2000 and after due to a bird survey protocol modification implemented in 2000.

**Table 6.4 SR 509 Erdahl Ditch Mitigation Site Bird Status**

| Common Name | Scientific Name | Status[30] |
|---|---|---|
| Barn Swallow | *Hirundo rustica* | Wetland-associated |
| Common Yellowthroat | *Geothlypis trichas* | Wetland-dependent |
| Great Blue Heron | *Ardea herodias* | Wetland-dependent |
| Red-winged Blackbird | *Agelaius phoeniceus* | Wetland-dependent |
| Willow Flycatcher | *Empidonax traillii* | Wetland-dependent |

Permit Requirement – No More Than 10% Aerial Cover by Non-Native Invasive Species
Aerial cover of non-native invasive species presently exceeds the threshold with an estimated value of 20% ($CI_{80\%}$ = 16-24% cover). Five non-native invasive species occur on the mitigation site. Species of concern include: *Phalaris arundinacea (reed canarygrass)*, *Polygonum cuspidatum* (Japanese knotweed), and *Rubus* species (blackberries).

## Management Activities

Olympic Region staff have used mechanical methods and spot spray herbicide applications to control *Rubus* species (blackberry), *Cytisus scoparius* (scotchbroom), *Cirsium vulgare* (bull thistle), *Cirsium arvense* (Canada thistle), *P. arundinacea*, and *P. australis.* Additional re-vegetation and aquatic herbicide applications are planned for fall of 2002.

[30] Birds are assigned an upland or wetland-dependent species status based on the classification scheme presented in Brown and Smith (1998). Regional variation occurs. Additional references used to further classify bird species include Thomas (1979), Ehrlich et al. (1988), and Smith et al. (1997).

# Appendices

# Appendix A

## SR 12 Black River Informal Success Standards

Monitoring tasks and associated management and sampling objectives were developed from the General Mitigation Strategy contained in the *SR 12 Vicinity Black River Bridge & SR 12 Vicinity Moon Road Combined Conceptual Wetland Mitigation Plan* (Russell 1998) and in consultation with Regional Staff. Permitting agencies did not require formal success standards. The criteria addressed this year are identified in **bold** font. Other tasks will be addressed in the indicated monitoring year.

**Standard #1:**
100% survival (or replacement) of trees and shrubs at the end of year one. Non-invasive volunteer species are acceptable in all zones and may be used in estimating percent cover of emergent species and credited toward survival of planted trees and shrubs.

**Standard #2:**
**Vegetative success must equal or exceed 80 percent survival of planted trees and shrubs by the end of year three, or additional planting (and monitoring) to achieve such.**

**Standard #3:**
**Hydrology (within 12 inches of the soil surface) within the wetland creation area must be present for at least 12.5% of the growing season (consecutive).**

**Standard #4:**
**Cover of reed canarygrass, or other invasive species may not exceed 20 percent of the total wetland area at any time during years one through five.**

# Appendix B

## SR 7 Nisqually Slough Success Standards

The following excerpt is from the Mitigation Plan *MP 40 to MP 42.5* (Russell 1999). The standards addressed this year are identified in **bold** font. Other standards will be addressed in the indicated monitoring year.

GENERAL GOALS

The general goal of the wetland mitigation plan is to create 3,300 square meters (35,522.10 square feet) of forested wetland, as well as enhance adjacent upland buffer area, which will provide wildlife habitat, groundwater recharge, and water quality functions. The following summarizes the goals that must be met by the third growing season after monitoring:

- Create a recognizable plant community that will develop into a forested wetland, and upland buffer community.

- Create a seasonally saturated wetland hydrologic regime that meets the criteria of the 1997 Washington State Manual (DOE, 1997), i.e., at least 12.5% of the growing season.

- Create a hydrologic connection between Wetland A (the slough of the Nisqually River) and the created wetland area.

The following summarizes the performance standards that the wetland creation and enhancement areas must meet:

- **100 percent survival (or replacement) of trees and shrub species at the end of year one. Non-invasive volunteer species are acceptable in all zones and may be used in estimating percent cover of emergent species and credited toward survival of planted trees and shrubs.**

- Vegetative success must equal or exceed 80 percent survival of planted trees and shrubs, and 80 percent cover of emergent species by the end of year five, or additional planting (and monitoring) to achieve such.

- **Hydrology (within 12 inches of the soil surface) within the wetland creation area must be present for at least 12.5% of the growing season (consecutive).**

- **Cover of reed canarygrass, or other invasive species may not exceed 20 percent of the total wetland area at any time during years one through five.**

The following summarized the performance standards that the upland buffer enhancement areas must meet:

- **100% survival (or replacement) of trees and shrubs at the end of year one. Non-invasive volunteer species are acceptable in all zones and may be used in estimating toward survival of planted trees and shrubs.**

**Using the Canopy Coverage Method during years 1-2, and the Line Intercept Method during years 4-5, the following standards of success for vegetative growth in all areas (as applicable) shall be met as shown in Table 10.1:**

**Table 10.1 Vegetative standards of success by year and layer for wetland creation and enhancement, and upland enhancement areas (as applicable).**

| | **Tree** | **Shrub** |
|---|---|---|
| **Year #1** | **20%** | **30%** |
| **Year #2** | 20% | 40% |
| **Year #4** | 40% | 50% |
| **Year #5** | 40% | 60% |

MAINTENANCE AND MONITORING PLAN

The following list features of the wetland creation project which will or may require on-going maintenance. Although it strives to include all potential maintenance needs, unforeseen problems are likely to arise. Therefore, it is essential that WSDOT personnel the site at least 2 times a year during the first two growing seasons following construction to assure that maintenance or corrections are promptly made. In addition to the 4 visits during years 1 and 2, monitoring will also occur in years 4 and 5.

- Loss of tree or shrub species (wetland and buffer species) for various reasons- replace or replant as needed.

- Presence of reed canarygrass, or other invasive species – hand pull monthly May-August, wick with approved herbicide as needed in late June/ early July.

- Poor growth of upland buffer plants – apply slow release balanced fertilizer.

Monitoring will occur regularly to measure the success of the wetland creation project and determine if the goals have been met. The following monitoring documentation will occur:

Vegetative Survival – Plant survival, species composition and vigor status will be measured in sample plots. The location of the vegetation sampling plots will be shown on the as-built planting plan. Survival of vegetation will be assessed after the first growing season, and at least once (July 1 to mid-August) in years 2, 4, and 5.

Hydrology – Hydrology will be measured by the placement of remote electronic wells to measure water depth. Hydrology will be measured once a day for at least the first year, and likely during the second year as well. If data during the first two years shows that the

hydrology criteria is being met, then hydrology will be measured only once during years 4 and 5.

Wildlife – Three formal bird surveys will be conducted each monitoring season from permanent census stations throughout the mitigation site. Surveys will take place between sunrise and noon, from May through June. Biologists will conduct the survey by standing silently at a station for five minutes, followed by five minutes of recording all bird species detected by sight or sound within 30 meters of the mitigation site. In addition to the surveys, any wildlife sign (e.g. tracks, scat), and/or other sightings will be recorded during all site visits. The bird surveys will be conducted during optimal weather conditions, i.e. little or no precipitation, and light to no wind, to ensure good visibility.

Fish – Because there is potential for fish species to utilize the mitigation site during high flows in the mainstem of the Nisqually River, sampling will be conducted to determine if fish are using the site, and if so, what species are present. Sampling will be conducted on the site at least once a year, during the late winter/early spring, when the smolts are moving downstream. Electroshocking will be the method used to sample the site. Sampling results will be documented as part of the monitoring report, and will include information about what species were observed, total number, and size.

Photo stations – A total of five photo stations will be located throughout the area. Each photo station will consist of a permanent marker where photographs will be taken at each compass point (N, S, E, and W) once a year in years 1, 2, 4, and 5 at the height of the growing season (July 15 to August 1). (These 20 photographs are available on request.)

At completion of construction an as-built plan will be prepared showing any deviations from the wetland creation plan. This can also serve as the baseline monitoring report. Monitoring reports will be prepared on a yearly basis for each monitoring year, and submitted to the appropriate regulatory agencies. Additional monitoring to assess and address maintenance issues will be performed from May through August for the first two years. These visits will include checking for the presence of invasive plants, damage due to vandalism, drought and any other unforeseen problems. These visits are necessary so that prompt control measures can be taken.

The boundary of the site will be fenced and signed to delineate the mitigation site, and to prevent degradation of the site by vandalism. Access to the site will be provided to allow WSDOT monitoring staff, and Pierce County regulatory personnel to evaluate the success of the mitigation.

CONTIGENCY PLAN

In the event that the goals and objectives are not met by the third year, contingency measures must be taken. These include but are not limited to replanting dead plants, hydrologic manipulation, irrigation, mulching of plants, weed control, trash removal, erosion repair, and any other practices necessary to meet the goals of the mitigation plan. Recommendations to correct deficiencies will be made after each site visit by the wetland biologist. WSDOT will correct deficiencies in a timely and responsible manner.

# Appendix C

## SR 161 Kapowsin Success Standards

**Success Standards**
The following excerpt is from the *MP 13 to MP 14 Safety Improvements (Junction Kapowsin Highway Vicinity SR 161 Wetland Mitigation Plan* (WSDOT 1998). The standards addressed this year are identified in **bold** font. Other standards will be addressed in the indicated monitoring year.

**GOALS AND PERFORMANCE STANDARDS**

The general goal of the wetland mitigation plan is to create or enhance approximately .12 hectares (.32 acres) of forested wetland, as well as enhance .12 hectares (.32 acres) of upland buffer area, which will provide wildlife habitat, groundwater recharge, and water quality functions. The following summarized the goals that must be met by the third growing season after monitoring:

- Create a recognizable plant community that will develop into a forested wetland, and upland buffer community.

- Create a seasonally saturated wetland hydrologic regime that meets the criteria of the 1997 Washington State Manual (DOE, 1997), i.e. at least 12.5% of the growing season.

- Maintain, but not expand, a hydrologic connection between Muck Creek and the created and enhanced wetland areas.

**The following summarizes the performance standards that the wetland creation and enhancement areas must meet:**

- **100% survival (or replacement) of trees, shrubs, and emergent species at the end of year one**. Non-invasive volunteer species are acceptable in all zones and may be used in estimating percent cover of emergent species and credited toward survival of planted trees and shrubs.

- Vegetative success must equal or exceed 80 percent survival of planted trees and shrubs, and 80 percent cover of emergent species by the end of year five, or additional planting (and monitoring) to achieve such.

- **Hydrology (within 12 inches of the soil surface) within the wetland creation area must be present for at least 12.5% of the growing season (consecutive).**

- **Cover or reed canarygrass, or other invasive species may not exceed 20 percent of the total wetland area at any time during years one through five.**

The following summarizes the performance standards that the upland buffer enhancement areas must meet:

- **100% survival (or replacement) of trees and shrubs at the end of year one.** Non-invasive volunteer species are acceptable in all zones and may be used in estimating toward survival of planted tress and shrubs.

- Vegetative cover (grass herbaceous material) in upland buffer areas is a minimum of 90 percent after year five.

Using the Canopy Coverage Method during years 1-2, and the Line Intercept Method during years 4-5, the following standards of success for vegetative growth in all areas (as applicable) shall be met as shown in Table 11.1:

**Table 11.1** Vegetative standards of success by year and layer for wetland creation and enhancement, and upland enhancement areas (as applicable).

| | Tree | Shrub | Emergent |
|---|---|---|---|
| **Year #1** | 20% | 30% | **30%** |
| **Year #2** | 20% | 40% | 50% |
| **Year #4** | 40% | 50% | 70% |
| **Year #5** | 40% | 60% | 80% |

**MAINTENANCE AND MONITORING PLAN**

The following list features of the wetland creation project which will or may require on-going maintenance. Although it strives to include all potential maintenance needs, unforeseen problems are likely to arise. Therefore, it is essential that WSDOT personnel the site at least 2 times a year during the first two growing seasons following construction to assure that maintenance or corrections are promptly made. In addition to the 4 visits during years 1 and 2, monitoring will also occur in years 4 and 5.

- Loss of tree or shrub species (wetland and buffer species) for various reasons- replace or replant as needed.

- Presence of reed canarygrass, or other invasive species – hand pull monthly May-August, wick with approved herbicide as needed in late June/early July.

- Poor growth of upland buffer plants – apply slow release balanced fertilizer.

Monitoring will occur regularly to measure the success of the wetland creation project and determine if the goals have been met. The following monitoring documentation will occur:

Vegetative Survival – Plant survival, species composition and vigor status will be measured in sample plots. The location of the vegetation sampling plots will be shown on the as-built planting plan. Survival of vegetation will be assessed after the first growing season, and at least once (July 1 to mid-August) in years 2, 4, and 5.

Hydrology – Hydrology will be measured by the placement of remote electronic wells to measure water depth. Hydrology will be measured once a day for at least the first year, and likely during the second year as well. If data during the first two years shows that the hydrology criteria is being met, then hydrology will be measured only once during years 4 and 5.

Wildlife – Three formal bird surveys will be conducted each monitoring season from permanent census stations throughout the mitigation site. Surveys will take place between sunrise and noon, from May through June. Biologists will conduct the survey by standing silently at a station for five minutes, followed by five minutes of recording all bird species detected by sight or sound within 30 meters of the mitigation site. In addition to the surveys, any wildlife sign (e.g. tracks, scat), and/or other sightings will be recorded during all site visits. The bird surveys will be conducted during optimal weather conditions, i.e. little or no precipitation, and light to no wind, to ensure good visibility.

Photo stations – A total of five photo stations will be located throughout the area. Each photo station will consist of a permanent marker where photographs will be taken at each compass point (N, S, E, and W) once a year in years 1, 2, 4, and 5 at the height of the growing season (July 15 to August 1).

At completion of construction an as-built plan will be prepared showing any deviations from the wetland creation plan. This can also serve as the baseline monitoring report. Monitoring reports will be prepared on a yearly basis for each monitoring year, and submitted to the appropriate regulatory agencies.

Additional monitoring to assess and address maintenance issues will be performed from May through August for the first two years. These visits will include checking for the presence of invasive plants, damage due to vandalism, drought and any other unforeseen problems. These visits are necessary so that prompt control measures can be taken.

**CONTINGENCY PLAN**

In the event that the goals and objectives are not met by the third year, contingency measures must be taken. These include but are not limited to replanting dead plants, hydrologic manipulation, irrigation, mulching of plants, weed control, trash removal, erosion repair, and any other practices necessary to meet the goals of the mitigation plan. Recommendations to correct deficiencies will be made after each site visit by the wetland biologist. WSDOT will correct deficiencies in a timely and responsible manner.

# Appendix D

## SR 509 Hylebos/Erdahl Ditch Success Standards

Excerpted from *Wetland Mitigation Plan State Route 509 East-West Corridor*, dated February 7, 1994 Washington State Department of Transportation District 3 Environmental Section.

**Goals, Objectives, and Standards of Success**

The mitigation package for these sites has several broad-based goals. First is the creation of the physical environment necessary to support and promote the development of wetland characteristics. The second goal is to establish wetland functions and values that either will be lost due to construction of the roadway or are limited in the region due to past practices. The most important of these functions and values include water quality treatment and habitat.

The wetland mitigation plan will create and enhance the general wetland functional values at the sites. General functional categories and the anticipated values attributable to these categories as a result of the mitigation project are as follows.

**Wildlife:**

These wetland areas should provide some habitat for wildlife species, principally birds and small mammals. None of the sites, because of their locations in an urban setting will be suitable for large mammals except for possible transient usage. The plant species selected will provide a food resource for wildlife species.

The wetlands will be suitable for some species of amphibians. The Hylebos site, because of its connection to the creek, will be of some value to fisheries.

**Hydrology/Water quality**

Water quality functions are the most important function of the existing wetlands within the corridor. The mitigation plan is primarily designed to replace any lost water quality treatment values resulting from the fills. The mitigation for the railroad pond should actually improve the water quality function over the existing pond value. Dense stands of vegetation will be established to facilitate the treatment of water within the wetlands. The vegetation will help attenuate flows and provide sediment trapping capability.

**Human values:**

The development of wetlands on these sites by WSDOT will preclude the use of these areas for its current economic value (industrial and commercial use). Public access will not be available at these sites and there will be no way for the public to access the wetlands from the road.

**Objective #1:**
Construct the mitigation sites concurrently with roadway construction with completion no later than one year after project construction. If possible, the contractor should schedule the mitigation as one of the first tasks.

*Success Criteria:*
Completion as per objective.

**Objective #2:**
Increase the acreage of wetlands in the Tacoma tide flat region.

*Success Criteria:*
Following five years of development and growth, the created wetland acreage within the mitigation sites, as delineated using the 1987 Corps manual, should exceed the acreage of the impacted wetlands.

Wetland acreage at the Blair Ditch Tributary (SR 509 Erdahl Ditch) should equal or exceed 0.44 of an acre.
Wetland acreage at the Hylebos mitigation site should equal or exceed 1.93 acres.

**Objective #3:**
Establish wetland and upland vegetation composition with appropriate structure.

*Success Criteria:*
At the end of the third year following the construction of the mitigation sites, areal coverage shall exceed 50%.

**At the end of the monitoring period, (5 years) the shrub and tree planted areas of Blair Ditch (SR 509 Erdahl Ditch) and Hylebos sites will have a minimum of 80% average areal cover that are appropriate to the sites and to its hydrologic regime.**

**At the end of the monitoring period, the Blair Ditch Tributary (SR 509 Erdahl Ditch) wetland seeding area should have a minimum of 90% areal coverage of wetland species (FAC+ or wetter).**

**The Hylebos mitigation site Lyngby's sedge planting area should have 50% areal coverage of native wetland species at the end of the monitoring period.**

**Objective #4:**

The wetland mitigation sites should provide wildlife habitat.

***Success Criteria:***
**Development of habitat diversity and structure will be determined by the diversity and numbers of wetland dependent species identified during the wetland mitigation monitoring program. The sites will meet this objective if wildlife species that utilize wetlands for some or all of their habitat requirements are located.**

**Objective 5:**
Creation of conditions in the Blair Ditch Tributary (SR 509 Erdahl Ditch) for water quality treatment that enhances it for this function.

*Success Criteria*
Dense vegetation establishment in the wetland (≥90% areal coverage) within the monitoring period.

Establishment within monitoring period of stable upland side slopes with a maximum 2:1 grade and dense buffer vegetation (greater than 80% areal coverage).

**Objective #6:**
Limit potential for contamination from the former UST site located at the Hylebos mitigation site.

*Success Criteria:*
Containment and removal of any contaminated soils found during grading activities at the Hylebos mitigation site.

## Permit Requirements

USACE IP 93-4-00148
"Special Conditions:

a. You must perform mitigation in accordance with the document entitled *Wetland Mitigation Plan State Route 509 East-West Corridor*, dated February 7, 1994. The Department of the Army hereby adds a series of conditions modifying parts of the mitigation document:"
    i. "Both wetland and buffer area plantings shall exceed 50% areal coverage after the third post-construction year."
    ii. "At the end of the monitoring period, the Blair Ditch Tributary (SR 509 Erdahl Ditch) wetland seeding area will feature no more than 10% areal cover by invasive species."
    iii. "Objective 4 is to 'Provide wildlife habitat at the wetland mitigation sites.'"
    iv. "**Success criteria for Objective 5 (page 17) shall include the requirement that at the end of the monitoring period the 90% areal cover of dense vegetation to be established in the Blair Ditch Tributary (SR 509 Erdahl Ditch) replacement wetland and the Hylebos Creek mitigation wetland shall include no more than 10% areal cover by non-native, invasive species**."
    v. "**Monitoring within the mitigation area shall be performed annually for the first three years after construction, and every other year for the next 6 years**."

**Department of Ecology Water Quality Certification 93-4-00148**
2.3 Monitoring of the wetland mitigation area shall be performed at least once a year for the first three years, and at least every other year thereafter until year 10.

# Glossary of Terms

**Abundance (total)** – the total number of individuals, cover, frequency of occurrence, volume, or biomass of a species, or group of species, within a given area.

**Accuracy** – the closeness of a measured or computed value to its true value.

**Adaptive management** – the process of linking ecological management within a learning framework (Elzinga et al. 1998).

**Aerial cover** – is the amount of ground covered by vegetation of a particular species or suite of species when viewed from above. Aerial cover is expressed as a percentage. Values for aerial cover are typically obtained from point-line, point-frame, or line intercept data.

**Areal estimates** – are made using the known boundary of a feature or statistical population. Areal estimates are often expressed in units of area.

**Aquatic vegetation** – includes submerged and rooted (*Elodea*, *Myriophyllum*) or floating (non-rooted) plants (*Lemna, Azolla, Wolfia*). For compliance purposes, these plants are not included in cover estimates. Vascular, rooted, floating-leaved plants *are* included in cover estimates (e.g., *Nuphar, Potamogeton*).

**Bare ground** – an area that can support, but does not presently support vascular vegetation.

**Canopy cover –** the coverage of foliage canopy (herbaceous or woody species) per unit ground area**.**

**Community** – a group of populations of species living together in a given place and time.

**Confidence interval (CI)** – is an estimate of precision around a sample mean. A confidence interval includes confidence level and confidence interval half-width.

**Cryptogam** – any of the *Cryptogamia*, an old primary division of plants comprising those without true flowers and seeds including ferns, mosses, and thallophytes (algae, fungi, and lichen).

**Density** – the number of plants per unit area (typically square meters).

**Densitometer –** a hollow T-shaped polyvinyl chloride (PVC) device that includes horizontal and vertical leveling and a mirror to locate a precise vertical point in space either directly above or directly below the densitometer. Target vegetation intersecting the vertical line of sight through the instrument is recorded.

**Herbaceous** – with characteristics of an herb; an annual, biennial, or perennial plant that is leaflike in color or texture, and not woody.

**Hydric soils** – soils formed under the conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register 1994).

**Invasive** – A plant that interferes with management objectives on a specific site at a specific point in time (Whitson et al. 2001). For monitoring purposes, invasive species include those listed on the current County Noxious Weed List, and on a site-by-site basis, other species may be included (such as *Rubus armeniacus* (Himalayan blackberry)).

**Line-segment** –a linear sample unit that is used to measure vegetative cover.

**Macroplot** – usually refers to a relatively large sampling area in which sub-sampling will be conducted, often using quadrats, line-segments or point-lines (Elzinga et al. 1998).

**Open water** – an area intended to be non-vegetated and permanently inundated as described in the site mitigation or planting plan.

**Point frame** – is a square or rectangular quadrat that consists of a set of identified points used to collect vegetation data.

**Point Intercept Device** – a tripod that supports a rod that can be leveled and lowered vertically to intercept target vegetation at an identified point.

**Point-line** – linear series of points comprising a sample unit.

**Point quadrat (points)** – a single point, used to sample vegetation data. The point quadrat is theoretically dimensionless.

**Population (biological)** – all individuals of one or more species within a specific area at a particular time.

**Population (statistical)** – the complete set of individual objects (sampling units) about which inferences are made.

**Precision** – the closeness of repeated measurements of the same value.

**Quadrat** – an area delimited for sampling flora or fauna; the sampling frame itself.

**Random sampling** – sampling units drawn randomly from the population of interest.

**Relative abundance (birds)** – the number of individuals per unit of sampling effort.

**Relative Cover** – The proportion of specific target vegetative cover compared to that of all the vegetative species in the community combined (Brower et al. 1998).

**Restricted Random Sampling Method** – a sampling method that divides the population of interest into equal-sized segments. In each segment, a single sampling unit is randomly

positioned. Sampling units are then analyzed as if they were part of a simple random sample (Elzinga et al. 1998).

**Sample** – a subset of the total possible number of sampling units in a statistical population.

**Sample size equations –** use sample mean and standard deviation to determine if data have been collected from enough sample units to meet the sampling objectives.

**Sample standard deviation** – a value indicating how similar each individual observation is to the sample mean.

**Sampling** – the act or process of selecting a part of something with the intent of showing the quality, style, or nature of the whole.

**Sampling objective** – a clearly articulated goal for the measurement of an ecological condition or change value (Elzinga et al. 1998). Sampling objectives provide a complement to success standards and describe the desired level of precision for sampling. Elements of a sampling objective include the desired confidence level and confidence interval half-width, or the acceptable false-change error and acceptable missed-change error level.

**Sampling units** – the individual objects that collectively make up a statistical population.

**Standard deviation** – a measure of how similar each individual observation is to the overall mean value.

**Shrub** – a woody plant which at maturity is usually less than 6m (20 feet) tall and generally exhibits several erect, spreading, or prostrate stems and has a bushy appearance (Cowardin et al. 1979). The species categories in this report follow Cooke (1997).

**Species richness** – the total number of species observed on a site.

**Structures** – any structure that is not expected to support vegetation during the monitoring period. Structures may include habitat structures, rocks, and other artifacts.

**Stratified Random Sampling Method** – The population of interest is divided into two or more groups (strata) prior to sampling. Within each stratum the sample units are the same. Sample units from different strata may or may not be identical. Random samples are obtained within each group (Elzinga et al. 1998).

**Systematic Random Sampling Method** – the regular placement of quadrats, points, or lines along a sampling transect following a random start.

**Transect** – For vegetation surveys, the transect is a line used to assist in the location sample units (point-lines, quadrats, line segments or frames) across the monitoring study area.

**Tree** – a woody plant that at maturity is usually 6m (20 feet) or more in height and generally has a single trunk, unbranched for 1m or more above ground, and more or less definite crown (Cowardin et al. 1979). The species categories in this report follow Cooke (1997).

**Vegetation structure** – the physical or structural description of the plant community (e.g. the relative biomass in canopy layers), generally independent of particular species composition.

**Wetland-dependent species (birds)** – restricted in temporal or spatial distribution to wetlands based on an intrinsic feature or features of the environment (Finch 1989).

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